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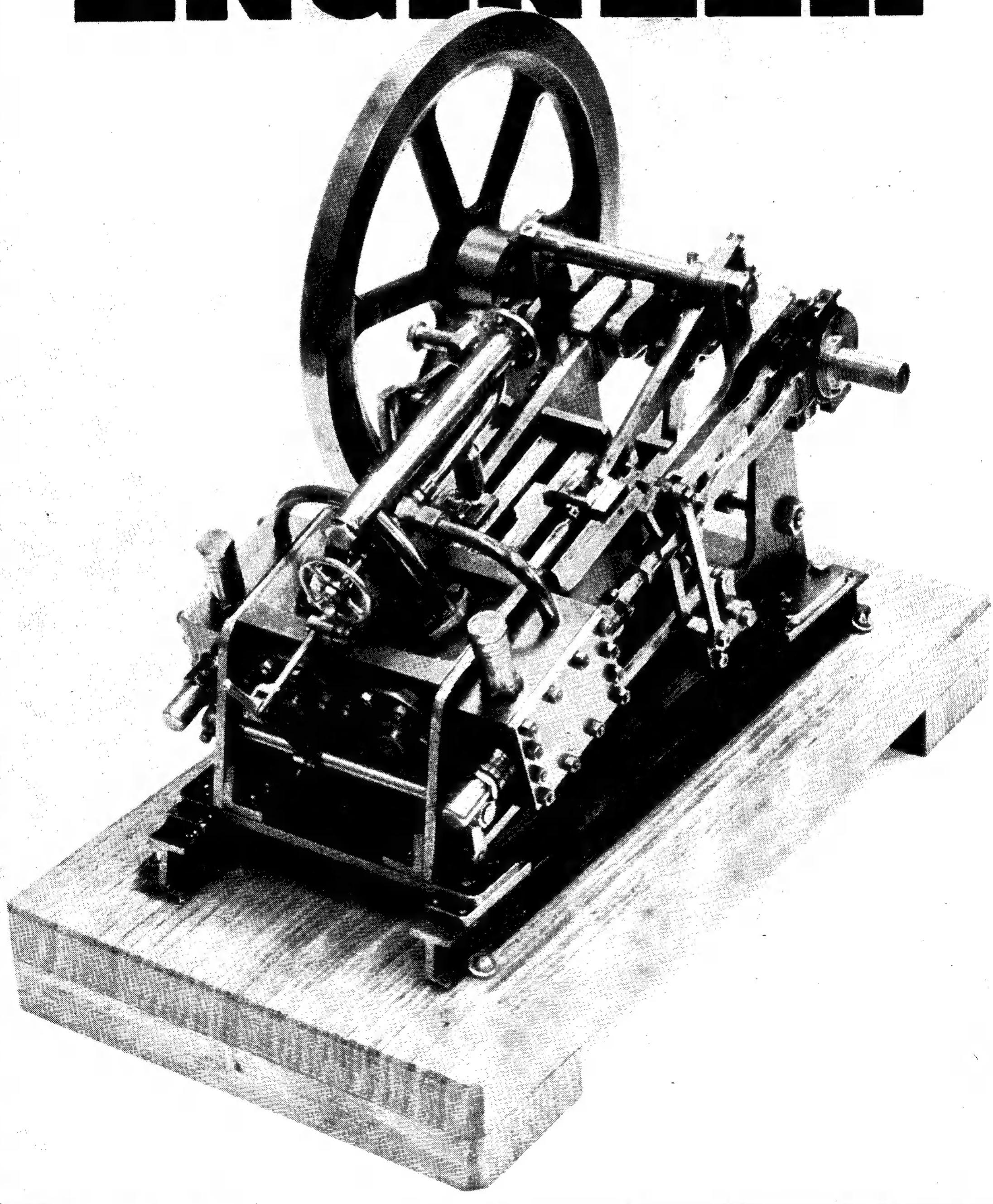
THE MODEL ENGINEER



The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

6TH MARCH 1952 VOL. 106 NO. 2650

SMOKE RINGS

Our Cover Picture

● WE ILLUSTRATE here an interesting model of a pair of paddle engines built by Dr. A. Livingston, of Oxford, and exhibited at last year's " M.E." Exhibition. The type of engine is one which is worthy of more attention from model power boat constructors, as it has been employed in full-size practice for many years in the propulsion of paddle tugs, ferries and passenger steamers, and is one of the most efficient methods of driving directly on the paddle shafts. In a model steamer, the primary attraction, apart from simplicity and efficiency of transmission, is the impressive appearance of slow-moving cranks and motion work, and general realism, which this type of engine makes possible. In this particular example, a feature of special interest is that the components have largely been adapted from locomotive practice, without being in any way incongruous or out of character. Plate frames are used, which is quite in keeping with marine practice for this class of engine, and the cylinders and motion were adapted from the 3½-in. gauge single-wheeler, *Jenny Lind*. Another photograph of the engine, with a brief description appeared in " L.B.S.C.'s " Lobby Chat in the issue of November 22nd last. The flywheel was added temporarily, in order to enable the engines to be run in under steam ; it would not be necessary in a marine installation, as the paddle wheels would provide sufficient momentum to ensure steady running.

Transport Models at S.A. Exhibition

● ABOUT THE middle of this month, the van Riebeck Tercentenary Exhibition will be opened in Cape Town, and there will be on view a most interesting and comprehensive collection of model railway and other miniature transport equipment. The models are mostly of British construction by manufacturer members of the Model Engineering Trade Association, and they comprise such items as model railway trains, track and equipment in 4-mm. and 7-mm. scales ; pre-railway vehicles of various kinds and examples of modern road passenger and freight conveyances. All these, collectively, demonstrate the development of transport in South Africa during the past 300 years.

A representative of the South African Government visited Great Britain towards the latter part of last year, and he got into touch with Mr. G. H. Lake, secretary of the M.E.T.A., with the result that about 95 per cent. of the contracts for models to be built for the exhibition were secured by the manufacturers in the Association. Time was short, since the contracts had to be completed and shipped to South Africa within five and a half months. We learn that all the orders were complied with in the stipulated time, and we think that the M.E.T.A. is to be warmly congratulated upon this most satisfactory transaction and upon rising so nobly to the opportunity of demonstrating British enterprise and skill.

Thames Models

● THE PORT OF LONDON AUTHORITY have recently built two impressive hydraulic scale models of sections of the River Thames—a pilot model and a main model, with horizontal scales of 1 : 3,000 and 1 : 600 respectively. They will be used, primarily, to study the ever-present problems of silting in the lower part of the estuary.

Any reader interested in seeing photographs of these models, together with a comprehensive description of their functions, may do so by referring to the issue of *The Engineer* dated February 1st, 1952.

Musical Boxes

● IN VIEW of the terrific interest and enthusiasm which have emanated since the appearance of the first "Smoke Ring" on the subject of musical boxes, the Exhibition Manager has expressed a desire to include them in the loan section at this year's MODEL ENGINEER Exhibition, which will be held, as before, in The New Royal Horticultural Hall, Westminster, from August 20th-30th, inclusive.

Will any reader having an instrument he would be prepared to exhibit on loan, kindly write, including details which will give some idea of the size and type, to The Exhibition Manager, 23, Great Queen Street, London, W.C.2.

Mr. A. J. Every

● WE ARE sorry to learn of the death, on February 10th, of Mr. A. J. Every, of Ealing. He had been in poor health for several years, but he managed to give his personal attention to his customers' needs until a few months ago. We regret to hear that, towards the end, he lost his sight.

Mr. Every was known to many of our readers through his blueprints and castings for model traction engines and other kinds of steam engines, and some of us remember a fine model travelling steam crane which he built and exhibited at one of the pre-war "M.E." Exhibitions. He retained his keen interest in this sort of thing until the end, and he always looked forward to and derived much pleasure from each issue of THE MODEL ENGINEER, in spite of his blindness. He had often advertised his products in our pages, and we know of at least one of his 1½-in. scale Burrell single-crank compound traction engines under construction as we write this note. He will be missed by many of our traction engine enthusiasts.

Model Stationary Steam Engines

● IN THE news sheet of a prominent model engineering society, the chairman comments on the present tendency to neglect the possibilities of the stationary steam engine as a prototype for modelling, and also mentions that there is a similar decline in really good models of marine engines. We agree with him that such engines offer a very wide variety of types, including beam, grasshopper, steeple, and table engines, to mention but a few, and the lack of interest in them is much to be deplored. At one time, these were among the most popular objects for model engineering attention, and were prominent at nearly all exhibitions, but very few of them have been seen in recent years. It is sometimes suggested that the fault may lie partly with THE MODEL ENGINEER in failing to publish good constructional articles on this class of engine; but in defence, if defence be needed, we would say that we have made and are still making every effort to obtain material (for publication in THE MODEL ENGINEER or our handbooks) which will assist our readers to construct authentic and realistic stationary engine models. Nearly four years ago, we opened negotiations with a well-known model engineer to produce an up-to-date book, replacing a very old and popular book in the "M.E." series, on the subject of steam engine models; recently the manuscript of this book was received by us and is now in preparation. Again, we have, at the request of many readers, who admired the fine stationary engine designs of the late Mr. H. Muncaster, arranged to republish, in an entirely new book, a selection of these designs. Readers will no doubt realise that, while it would be quite easy to produce either articles or handbooks describing engines of a sort, a good deal of very careful research work, not to mention the making of many accurate drawings, is necessary in order to provide them with precise and adequate data to enable them to construct models which will reproduce with due fidelity the engineering marvels of the past.

The Hobby Continues to Grow

● IN A letter from Mr. T. Watson Forgie, of Kirkwall, Orkney, he tells simply that he has started a model engineering society there and that the second meeting will be held in March. This is interesting and welcome news, and we wish well of the new venture; we shall always be glad to hear how it gets on.

It is certainly in good hands, for not only is Mr. Forgie organist and choirmaster of the St. Magnus Cathedral, Kirkwall, but he has been a member of the Glasgow Society of Model Engineers for years. Here we have another instance of interests in music and engineering going hand in hand.

It is possible that most model engineers would regard the Orkney Islands as something of an outpost of Britain, and may even be surprised to learn of an interest in model engineering in such a place; but Mr. Forgie is evidently assured of adequate support for his venture and confident of its future success. Just in case there may be some readers in Kirkwall who have not yet heard of Mr. Forgie's new society, we append his address, which is 5, East Road, Kirkwall.

Secretarial Changes

● WE HAVE been informed of two recent changes of secretary, and all readers concerned are requested to make note of them. The first is in the Edgware and District Society of Model and Experimental Engineers, the hon. secretary of which is Mr. T. Morris, 81, Goldsmith Lane, Kingsbury, N.W.9. The second is in the Urmston and District Model Engineering Society, of which the new hon. secretary is Mr. E. B. Spencer, 46, Glenhaven Avenue, Urmston, Lancs.

" Talking about Steam——"

by W. J. Hughes

A series of articles intended to supply suggestions and information for the would-be "modeller in steam" who has not the time, the inclination or the opportunity for extensive research

2: *General Construction of Traction Engines

AS might be imagined, the *detail* design of traction-engine cylinders varied considerably, but even here certain similarities prevailed. For example, in a single-cylinder engine the valve-chest was normally at the left-hand side and so was the flywheel, but Aveling & Porter and also Green, of Leeds, both built engines with the *cylinder* to the left, probably in order to bring the crank closer to the flywheel for belt work, or to allow more room for the gearing on the right in the case of the Green.

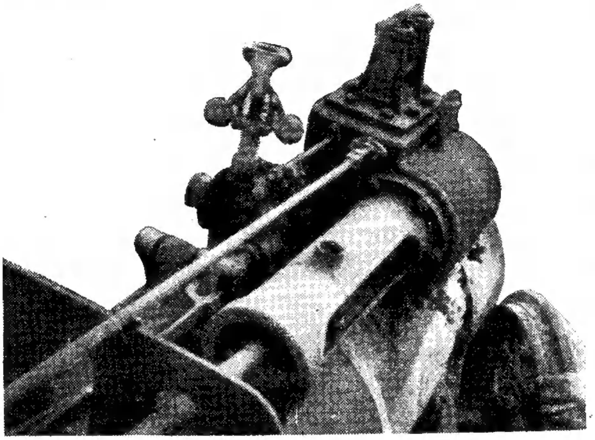


Photo by] [*W. J. Hughes*

Photograph No. 5. Trunk-guide of an Allchin traction-engine : note the cross-arm governor, regulator-rod, and safety-valves

With compound cylinders, the valves may be on top, or at the sides. If on top, the port-faces may be inclined to line valve-gear up with crankshaft. Alternatively, they may be horizontal, with the valve-rods worked by rocking-levers from the eccentric-rods. One firm, Clayton & Shuttleworth, fitted a form of Joy's radial valve-gear to work valves-on-top, and Marshall's fitted their own radial gear on later engines and rollers. Apart from these and a few others, Stephenson link motion may be said to be the usual valve-gear both on single-cylinder and compound engines.

The cylinder flange may be radiused to fit the boiler barrel, and bolted thereto, but several firms abandoned this type of fixing. They riveted a pressed steel plate or a casting to the boiler to form a flat seating for the cylinder. Both cylinder base and seating were planed, and bolted together, the motion-plate being similarly fitted.

Cylinders were steam-jacketed, with a " steam-dome " formed in the top of the casting, which accounts for placing the safe y-valves, regulator-valve, and governor valve here. Safety-valves were commonly of the Ramsbottom type, but occasionally pop-valves were fitted. (Early engines usually had Salter-type safety-valves.) Governors, where fitted, were of assorted makes, but probably the Pickering and cross-arm types were the most popular. Sometimes they were mounted directly on the cylinder block but sometimes on the motion-bracket.

A trunk was frequently used to guide the cross-head, but some makers—notably Fowler and Burrell—preferred slide-bars.

The design of connecting-rod depended on the ideas of the designer. Fower's used the forked little-end, but most makers preferred the solid-eye type, with wedge-block adjustment, fitting into a box-type crosshead. Big-ends usually had a strap-and-cotter adjustment, but the marine-type was not entirely unknown. The rod itself was turned and polished ; at the little-end the diameter should be equal to that of the piston-rod, tapering up to $1\frac{1}{2}$ times the same diameter at the big-end.

On single-cylinder machines the " bent from a solid bar " crankshaft was the more popular, but on compounds, which had no room to spare, the " machined all over " type was more frequent, often with balance weights bolted on.

Flywheels

On tractors and road-locomotives, as we have remarked, the flywheels were of the disc-type, but on traction-engines they were spoked, usually with six spokes. The face of the flywheel was crowned for belt-driving, and the wheel was sometimes " dished "—even the spoked variety.

*Continued from page 214, " M.E.," February 14, 1952.

Conversely, when both gears are in neutral, it is necessary to tilt lever *E* to lift the nib. This rides across *D* as the latter is moved to engage the fast-speed pinion, but at the end of its travel *D* *still supports the nib*. The other end of *E* being thus depressed, then clearly it is impossible to move *C* to bring the slow-speed pinion into engagement at the same time.

In an article later in this series I hope to describe arrangements for three-speed engines, and also other interlocking devices, but meanwhile let us press on with the remainder of the drive.

Differential or Compensating Gear

Almost invariably an old traction-man will refer to " compensating-gear " where most model engineers would use the term " differential," so I propose to do the same. Many readers will be aware how this gear works on a motor vehicle —and the traction-engine arrangement is very similar in essentials—but for the benefit of the tyro, here is a brief explanation.

When a four-wheeled vehicle turns a corner, the outside wheels turn a larger circle than the inside ones, and so must make more revolutions in the same space of time. The compensating-gear is fitted to allow of this whilst at the same time allowing both wheels to be driven. If we examine Fig. 6, which is a cross-section of the hind-axle of a Davey-Paxman engine, this will help us to see how it works.

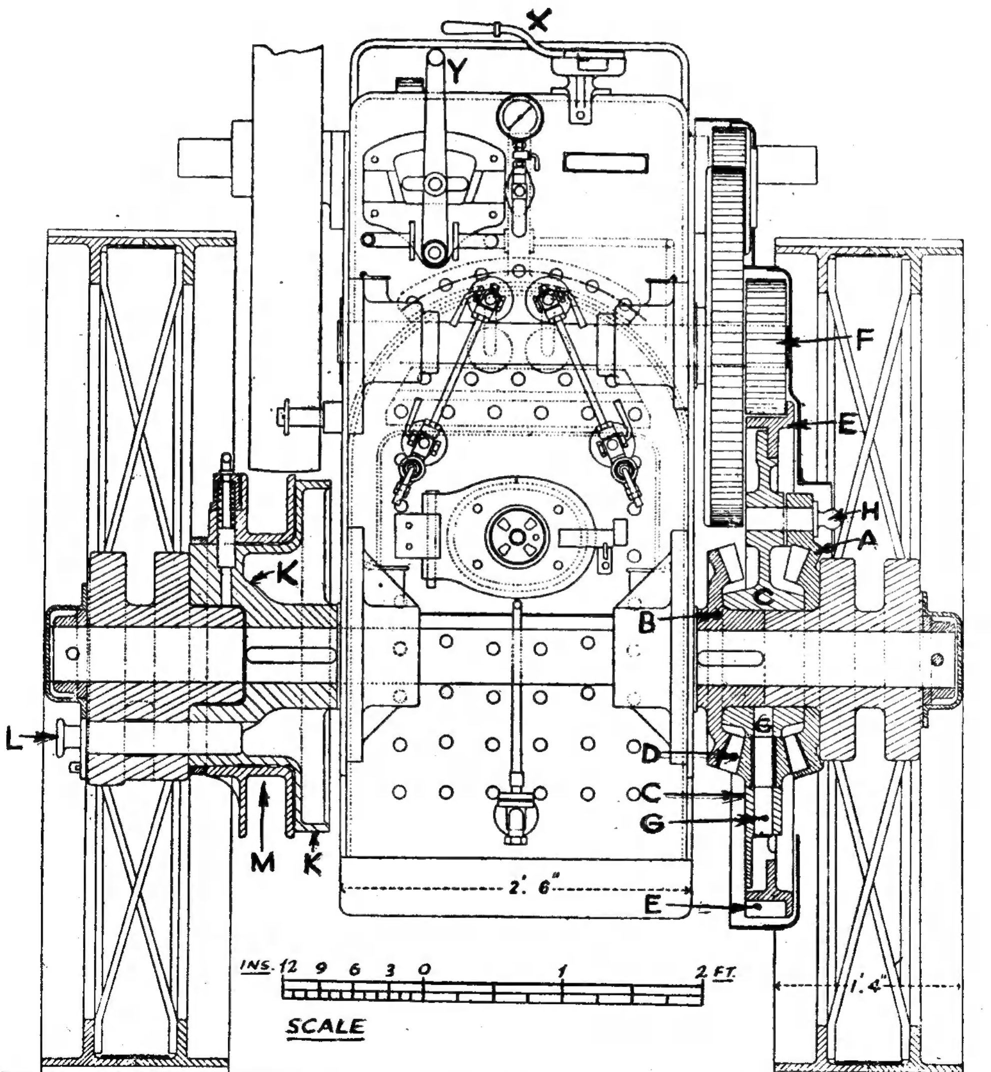


Fig. 6. Cross-section through hind axle of Davey- Paxman engine, reproduced by permission of the builders

Bevel wheel *A* is bolted firmly to the boss of the road-wheel, which runs loose on the hind axle. Bevel-wheel *B* is keyed to the hind axle, however. Compensating-centre *C* runs free on the bosses of the hind wheel and of bevel-wheel *B*: it is a kind of frame carrying three bevel pinions, of which *D* is one. *D* is free to revolve on the pin *G*, and it meshes with both bevel wheels, as do the other two pinions similarly. The spur-ring *E* is bolted to the machined outer edge of *C*, and is driven by the pinion *F* on the third shaft.

Now, in running on a straight road, the compensating-centre *C*, driven by *F*, transmits the power to bevel-wheels *A* and *B* through bevel-pinion *D* (and its two fellows which we will call D_1 and D_2). These *do not revolve* on their pins, but merely act as dog-clutches. As we have seen, *A* is bolted to the right-hand wheel, and *B* is keyed to the hind axle, which drives the left-hand wheel in a manner to be described later. So both wheels will rotate at the same speed.

But let us imagine the right-hand wheel to be chocked, so that it cannot rotate; then neither can bevel-wheel *A*. The compensating-centre *C*, however, continues to be driven by the engine, and it is allowed to continue rotating by the bevel-*pinions* D, D_1 and D_2 "running round" bevel-wheel *A*. In doing so, they rotate on their pins G, G_1 and G_2, and in turn drive bevel-wheel *B* forward, so transmitting the power to the left-hand wheel. Incidentally, this will revolve at twice its normal speed.

Now, when turning a right-hand bend, the left-hand wheel meets less resistance than the right-hand one, and will thus speed up while the other slows down: this applies in opposite when turning a left-hand bend. The important thing, however, is to remember that although one wheel is rotating faster than the other, *both are still being driven.*

A big trouble with compensating gear is that if one wheel meets little or no resistance, as in mud, that wheel will revolve madly while the other stands still. On traction engines one could lock the compensating-gear to prevent this happening: in the Paxman engine this was accomplished by inserting the pin *H* through a hole in a boss cast on bevel wheel *A* and through a corresponding hole in the compensating-centre. On other engines a longer pin was used, passing through the hub itself into the compensating-centre.

No doubt it will be news to many readers, by the way, that this form of compensating-gear was fitted to a steam-carriage as long ago as 1833!

Drive to the Left-hand Wheel

We have seen that the bevel-wheel *B* is keyed to the hind axle. At the other end of the axle, a driving boss *K* is similarly keyed, and the left-hand wheel is driven from this by means of the pin *L* which fits through a hole in the hub into a corresponding hole in *K*.

On its inner periphery, next to the horn-plate, the latter is machined to form the brake-drum, and its outer boss forms a machined bearing for the winding drum *M*, which is shown locked to *K* by means of the spring-loaded latch at the top. When it was desired to pay out the wire winding-rope, this latch could be pulled out, when the drum could revolve free on its boss.

The method of using the drum was as follows: The driving-pin *L* was removed, and both hind wheels chocked so that the engine could not move. With the latch engaged to drive the drum, the regulator was opened gently. Since bevel-wheel *A* was held immovable, the bevel-wheel *B* would be driven round at twice the speed of the compensating-centre, carrying the hind axle, driving boss, and winding drum with it.

It should be realised that the arrangement of final drive, winding drum, etc., above described, is only one of many and before modelling any particular prototype it is necessary to study its own design closely. But this, of course, applies to *all* the details, doesn't it?

(To be continued)

A Traction Engine to the Rescue!

Recently, at Minster Lovell, on the Witney-Burford road, Oxfordshire, a collision occurred between two lorries, with the result that one of them, a big six-wheeled vehicle loaded with timber, skidded into a ditch and fell over on its side. Fortunately, nobody was very seriously hurt; but the attempts to right the overturned lorry developed into quite a problem. Eventually, Mr. S. J. Wharton, a nearby garage proprietor, was called in to help, and he, of all people (!), *got up steam in a Burrell showman's engine* which he possesses. This engine is named *King George VI*, and was built by Burrells in 1921. Unfortunately, while manoeuvring for the best position from which to pull the overturned lorry back on to its wheels, *King George VI* became bogged at the side of the road and had to be pulled out by two petrol-driven breakdown vehicles. We are glad to be able to report, however, that after this temporary and purely accidental humiliation, the Burrell renewed its efforts to rescue the lorry and succeeded where the other two vehicles had failed. This is but one more illustration of the comparatively gigantic pulling power of these erstwhile monarchs of the road.

A Model Engineering Exhibition at Bath

by A. Smith

TOWARDS the end of 1951, the Rotary Club of Bath held their bi-annual Hobbies Exhibition, in which the Bath and District Society of Model and Experimental Engineers were requested to take part.

Their exhibit consisted of a display of members' work together with a model engineering workshop which was kept in operation during the whole of the four days that the exhibition was open. The equipment in use consisted of a 3½-in. lathe, driller, and power saw.

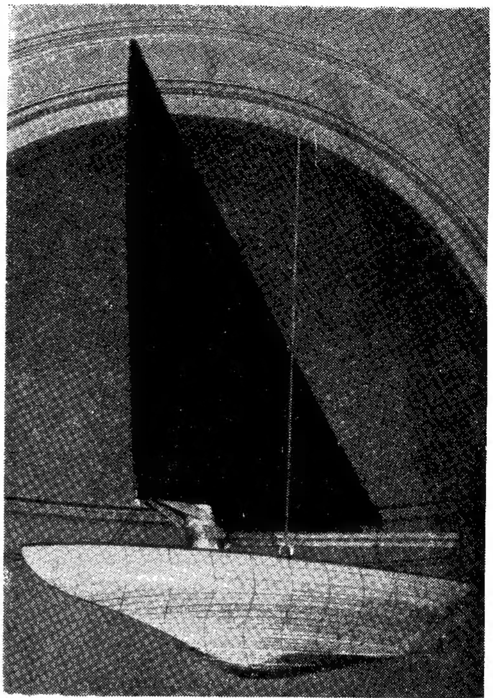
As is usual, steam models formed a large proportion of members' exhibits, the centre-piece being a 3½-in. gauge *Hielan' Lassie*, the work of Mr. A. Cutter. Mr. G. Maples showed his 2½-in. gauge *Southern Maid*, an example of really high-class craftsmanship. A 2½-in. gauge *Princess Royal* and an unfinished 3½-in. gauge *Marina* illustrated the beautiful work that the society has learnt to expect from Mr. Buckeridge. The chassis and cylinders for a 5-in. gauge *Ann of Holland* was exhibited by Mr. Garraway; this promises to be a fine and powerful engine.

Road locomotives were not forgotten, Col. W. L. A. Feddon having on display his 2-in. scale Foden Steam Waggon. He also showed two small high-speed stationary engines.

Boats appear to be our second strength in the society a yacht and dinghy by Col. Feddon and an A.S.R. launch by Mr. Chapman being displayed.

The yacht by Mr. McGruer (of McGruer Hollow Mast fame) is worthy of special mention. This is a model of the full-size boat which he has designed and built, and is used to describe the principle of the design.

A photograph shows *Ecossaise* suspended in a sailing position. The boat has two new features,



Model of the 12-metre yacht "Ecossaise" by Mr. E. McGruer

the double sailing rig, and the otter keel, as Mr. McGruer describes it. The photograph shows the boat on the port tack with the moderate weather sail. For light winds and zephyrs a longboat sail is used to the maximum area permitted by the rating (12-metre cruiser racer yachts). In a storm, the luff-spar is trained aftside the mast and streamlined by a storm sail extending fully half-way along the booms, these, and the luff-spar being controlled by the port and starboard sheets.

Workshop equipment was well to the fore. Mr. Willis showed a useful accessory in the form of a set of Acme thread taps as used for the feed-screws on the ML7 lathe.

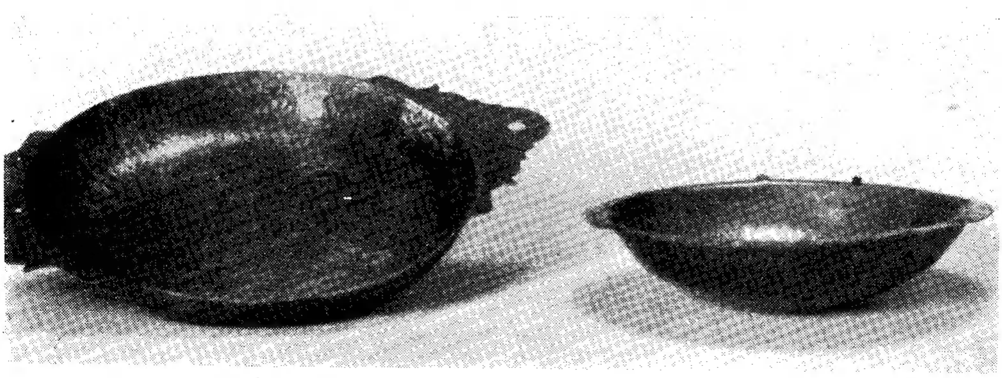


Photo by] [*A. Smith*

Copper bowls, by a member—no doubt to placate the domestic boss

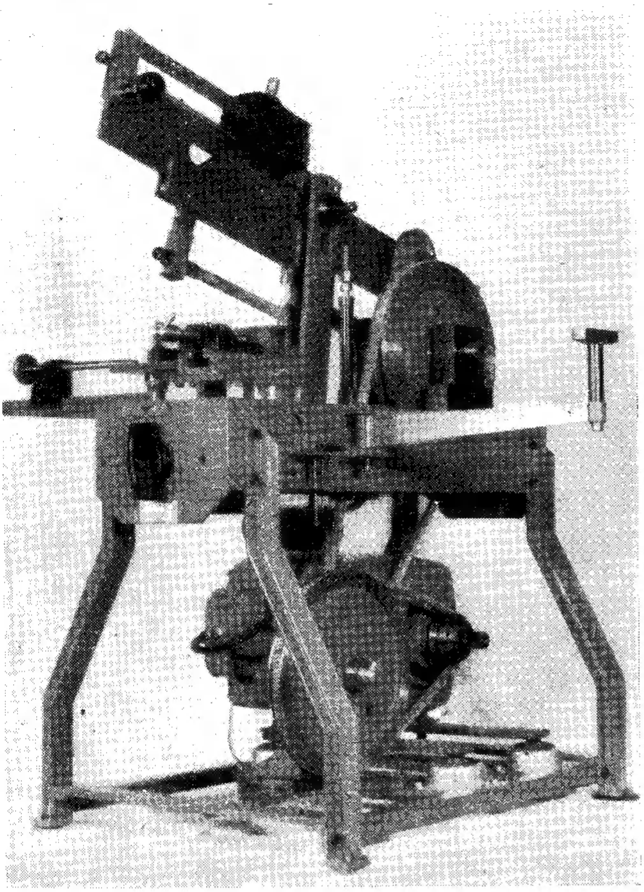


Photo by] [*A. Smith*
Mr. Edmond's power hacksaw based on the design by "Duplex"

A power hacksaw by Mr. R. N. J. Edmonds, caused great excitement while operating in the workshop. The design of this saw is based on the description given by "Duplex" in THE MODEL ENGINEER, but, with all respect to "Duplex," the design has been "Edmondised." The saw bed has been re-designed, and is now of box form, with the motor and countershaft underneath. The saw frame carrier has also been modified to reduce the length of the slot in the support arm and to increase the distance between the bearings of the saw frame carrier, with the result that the overturning moment of the saw frame carrier is reduced and the sawing pressure taken by the bearings on the underside of the support arm only. For reasons of silence in operation, Mr. Edmonds has used a V-belt for the final drive to the saw; the motor is resiliently mounted.

The micro-switch, placed within the box bed is operated by a push-rod, and does not require a resetting device. Ball-bearings are used throughout, and the main slides are lubricated by felt pads located inside the saw-frame carrier. Attachments have been provided so that material can be cut to length on repetition work. A support is also fitted to carry long bars, so relieving the vice of any unnecessary strain.

The value of the publicity, which the society obtained from this exhibition has been immense, and our numbers have increased considerably.

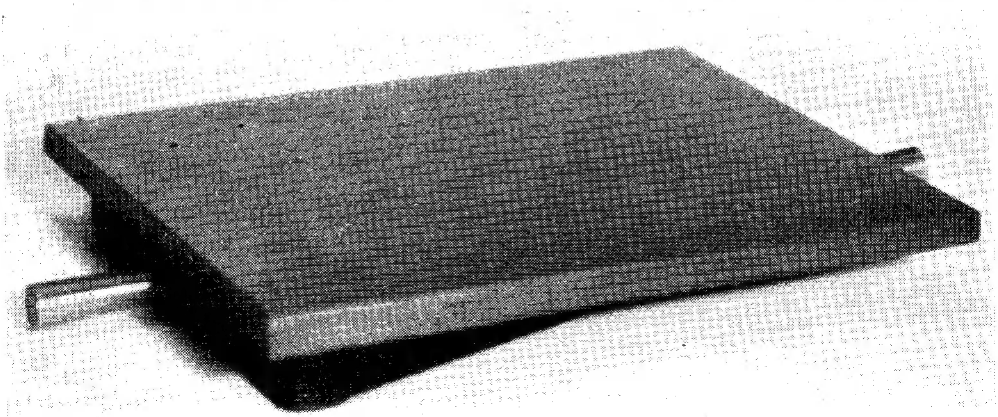


Photo by] *A 8 in. × 6 in. surface plate machined on an M.L.7 lathe* [*A. Smith*

IN THE WORKSHOP

by "Duplex"

No. 110.—*Using Calor Gas

THE clamping device, to which reference has already been made, consists of four main components, as illustrated in Fig. 8. A combined swivel and clamping-piece *A* provided with a locking lever and wing-nut. A vertical standard *B* to which is screwed a clamp *C* for holding the torch clamp *D*. In addition to these parts, there is a bracket bolted to the brazing hearth for holding the clamping-piece, and a strut which serves to make the bracket rigid. These parts are illustrated in Fig. 9. The parts for the clamping device are all of simple character and do not merit detailed constructional description.

The length of the vertical member *B* will depend to some extent upon the form of stand that is used to support the brazing hearth. The dimensions given in the detail drawing apply to the device shown attached to the stand illustrated in Fig. 6 and these measurements will probably be found sufficient for most applications. In the illustration Fig. 8 that shows the parts individually, the vertical member is, of course, a dummy.

Air Supply

The apparatus needed to maintain an adequate

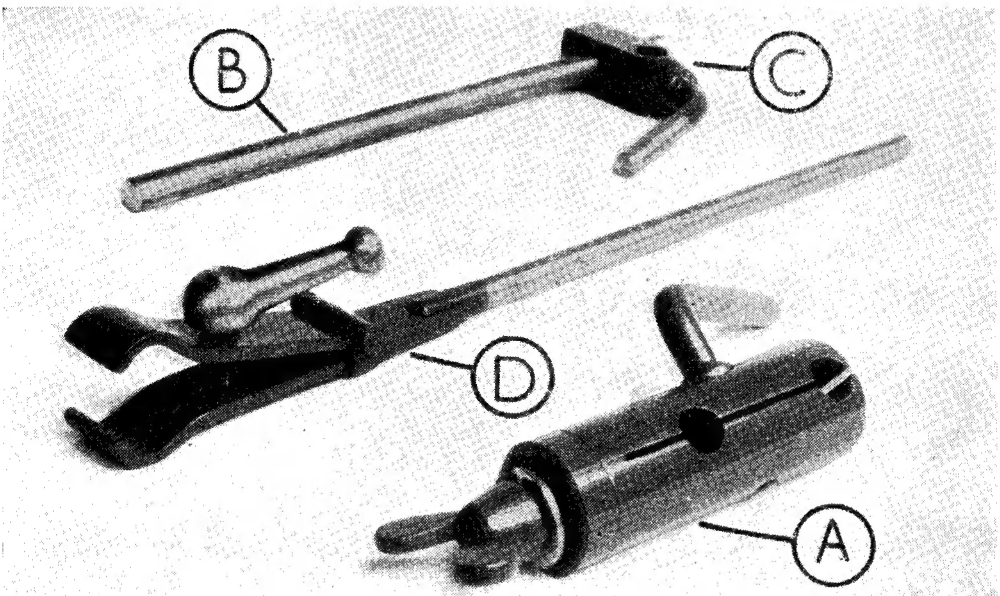


Fig. 8. *Parts of the clamping device.* (*A*) *Clamping-piece* ; (*B*) *Vertical standard* ; (*C*) *Clamp* ; (*D*) *Torch clamp*

It should be noted, however, that the forming of the jaws of the clamp must be carried out with the material at red-heat, and this also applies to the making of the hinge-end of the moving jaw. In order to thicken the metal at this point, the work, when red hot, is turned back upon itself, and then filed to shape and drilled for a No. 5 B.A.screw, as illustrated in Fig. 10. The details of the four parts of the clamping device are given in Fig. 11, *A*, *B*, *C*, *D*.

air supply in the workshop has already been described in an article to which reference has been made. But there are aspects concerning the use of air in connection with Calor gas brazing torches that deserve special attention. In the first place it should be noted that perfect combustion of Calor gas needs 25 parts of air to one of the gas. Secondly, the pressure of air required is only between 5-10 p.s.i.

Any air-compressing apparatus should, therefore, be capable of supplying a considerable volume of air at a moderate pressure. The Calor Gas Co. state in their lists the gas consumption of

*Continued from page 254, " M.E.," February 21, 1952.

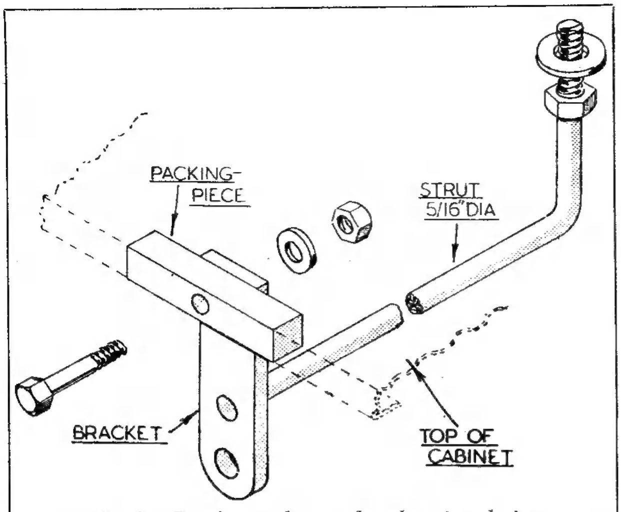


Fig. 9. Bracket and strut for clamping device

their various torches; it is, therefore, a simple matter to decide the volume of air which is needed for working one of these appliances efficiently.

For example, a SPQ. 26 torch consumes 6.2 cu. ft. of gas per hour when full on, therefore, 25 times this amount of air per hour will be needed to supply the torch, that is to say 155 cu. ft. of air per hour must be supplied. As compressors are rated at so many cu. ft. of free air per minute, apparatus, capable of delivering $\frac{155}{60}$ cu. ft. per min. or a minimum of $2\frac{1}{2}$ cu. ft. per min. will be required. Experience with the compressor seen in the illustrations showed that the build-up of pressure in the air line, resulting from controlling this air supply by means of the tap fitted to the torch itself, caused the hose to blow off the end of the pipe, and was also apt to extinguish the flame unless considerable care was exercised in handling the control tap.

It was decided, therefore, to devise a simple safety-valve which would unload the air line before either of these troubles could occur. The valve, together with the connections for the air compressor and the air hose leading to the brazing torch are illustrated in Fig. 12. As will be seen from this illustration and the sectional drawing, Fig. 13, the device consists of a base *A*, a cover *B* fitted with spring compression adjustment, and a disc valve *E*. It will be observed that the cover is held to the base by no less than twelve screws. This is, of course, a quite unnecessary number; the reason is that originally the base and cover were made for another purpose. As will be seen in the drawings of these parts, provision is made for six screws only.

The details of the various components of the valve are shown in Fig. 14. There is nothing in the machining of the parts that is in the least degree difficult. The base *A* is most conveniently made from a piece of flat mild-steel of the requisite thickness, whilst the cover *B* may be built up by silver-soldering, or even by sweating if made from brass, since the load on the parts is light.

The disc valve *E* is machined from brass bar, as the centralising lugs are last formed by milling in the lathe with the work gripped in the self-centring chuck using a simple indexing device such as has been described many times in the past, and a milling attachment mounted upon the lathe cross-slide, as shown diagrammatically in Fig. 15. When the lugs are formed by filing, the face of the valve should afterwards be lightly machined to remove any file marks resulting from this.

Special Points to Note

(1) Calor gas is a highly inflammable gas, therefore see that all pipe unions and taps are sound.

(2) When finishing work, turn off the gas supply by means of the cylinder valve first, then let all residual gas burn itself out before closing other taps in the system.

(3) When lighting torches, turn on cylinder valve slowly so as to have a small flame initially. This applies particularly to the lighting of torches using compressed air, where it is necessary to start with a yellow flame (no air) and gradually increase both

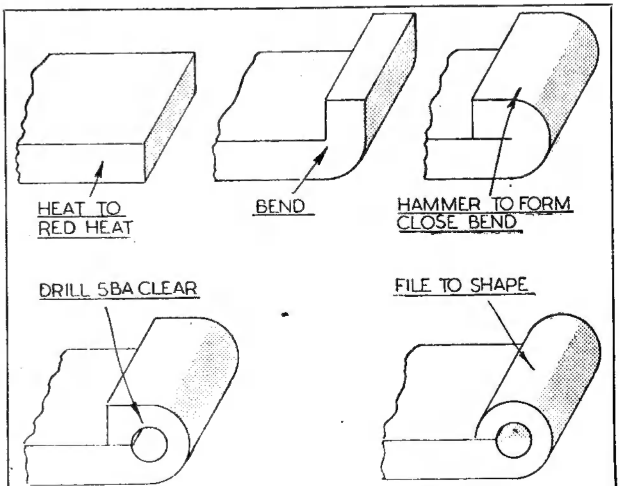


Fig. 10. Making the hinge-end of the moving jaw

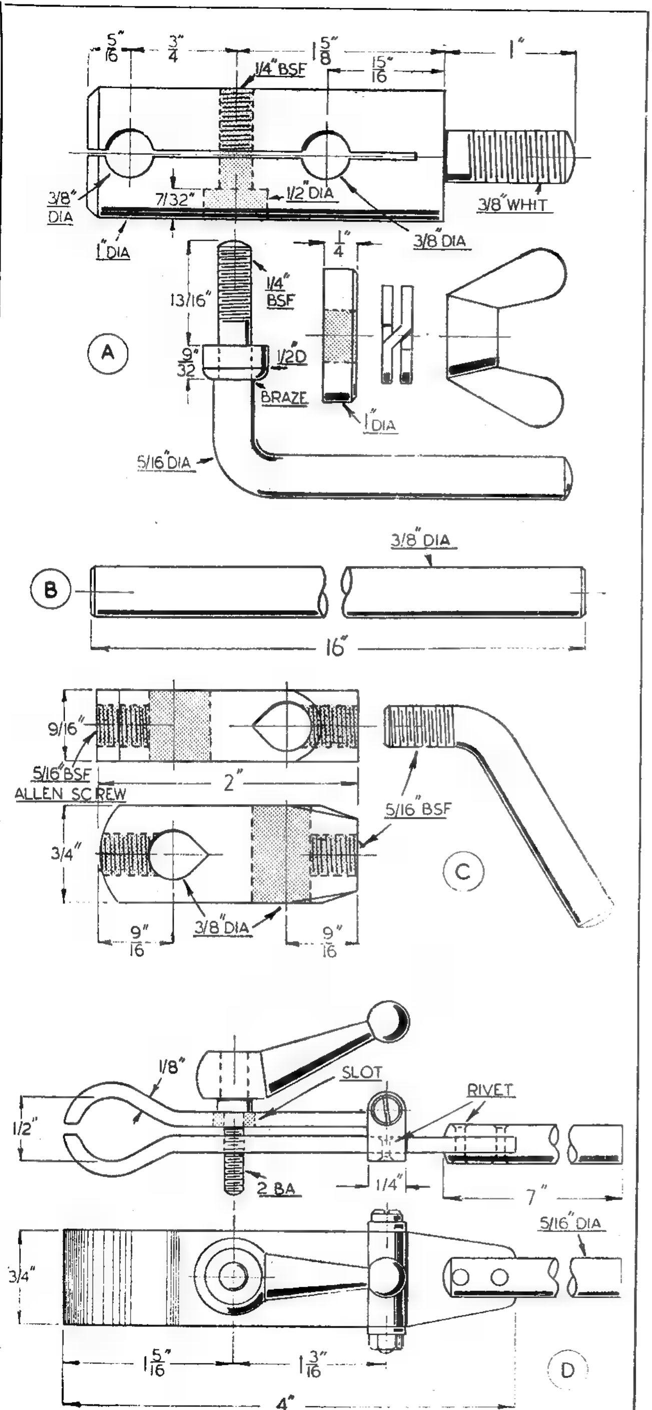


Fig. 11. Details of the clamping device. Parts "A," "B," "C" and "D"

gas and air until the required blue flame is produced.

(4) Always make sure that the fibre washers used in connecting regulators to cylinders are sound. If in doubt, replace by a new one.

(5) Apparatus designed for town gas is *not* suitable for use with Calor gas.

(6) Do not uses hoses which are in poor condition.

Using Calor Gas Equipment

As the calorific value of Calor gas is high, there is no need, when silver-soldering or brazing small parts to pack the work extensively with fireclay blocks or chips.

In this way the work is more readily accessible during the brazing operation.

Work that has already been fluxed before being placed on the hearth should be heated slowly to keep the flux from sputtering. This is important when active fluxes are used, for the neatness of the brazed joint depends to a large extent upon keeping the flux from spreading over the work. For this reason, fluxing material should always be used with discretion. The same remarks apply, with no less force, to the amount of brazing spelter used. Too much spelter will make a joint that must be filed smooth before it is presentable. The correct quantity of brazing material, properly fluxed, leaves the joint perfectly clean with a neat fillet of spelter at the junction of the parts; all that is then needed to clean the joint is vigorous scouring with a wire brush.

Experience has shown that satisfactory results will be obtained if powdered spelter, mixed with an appropriate flux, is applied to the work carefully before heating. After the flux-spelter mixture has been applied, the work is placed on the hearth and is heated evenly until the brazing material is seen to fuse. The heat is then maintained to make sure that the molten spelter permeates the joint thoroughly. The heating should not, however, be prolonged unduly; 10-15 sec. is usually sufficient for work that has been evenly heated. The above remarks apply, of course, to small work only; the method described

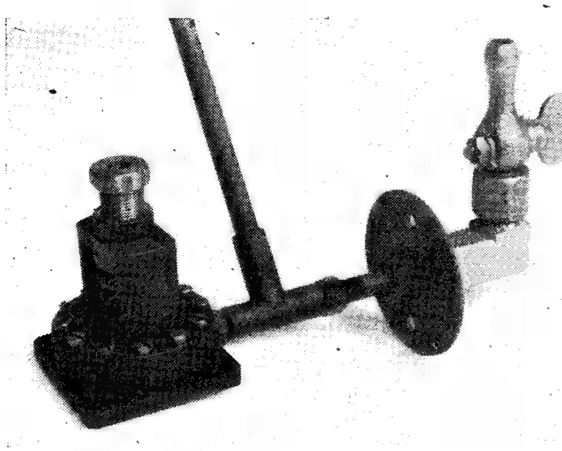


Fig. 12. *The safety-valve and air-line connections*

however, may well be adopted when brazing larger parts, provided that additional spelter is fed to the work in the form of brazing strip. Care is necessary, however, to avoid applying too much of the material.

Many readers will be familiar with Johnson-Matthey's "Easyflo" silver-solder and with the same firm's "Tenacity" flux. Both these products are, of course, excellent, and have always given satisfactory results. Their use, in the circumstances mentioned previously, can be recommended with confidence. Johnson-Matthey of Hatton Garden, London, E.C.1., can also supply silver-solder in powdered form, as well as in the strip variety. Readers needing further information are advised to apply to them directly. Powdered silver-solder is used mixed together with flux to form a paste. The paste is applied to the work so as to form a fillet along the line of the joint. When heat is applied, the flux in the paste melts and runs into the joint where, as soon as the work has been raised to the solder's melting point, the flux is followed by the solder. In this way a neat hard soldered joint combined with economy of silver-solder, is made.

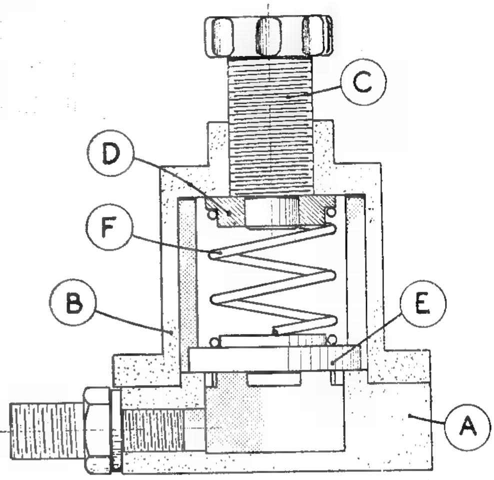


Fig. 13. *Section of the safety-valve*

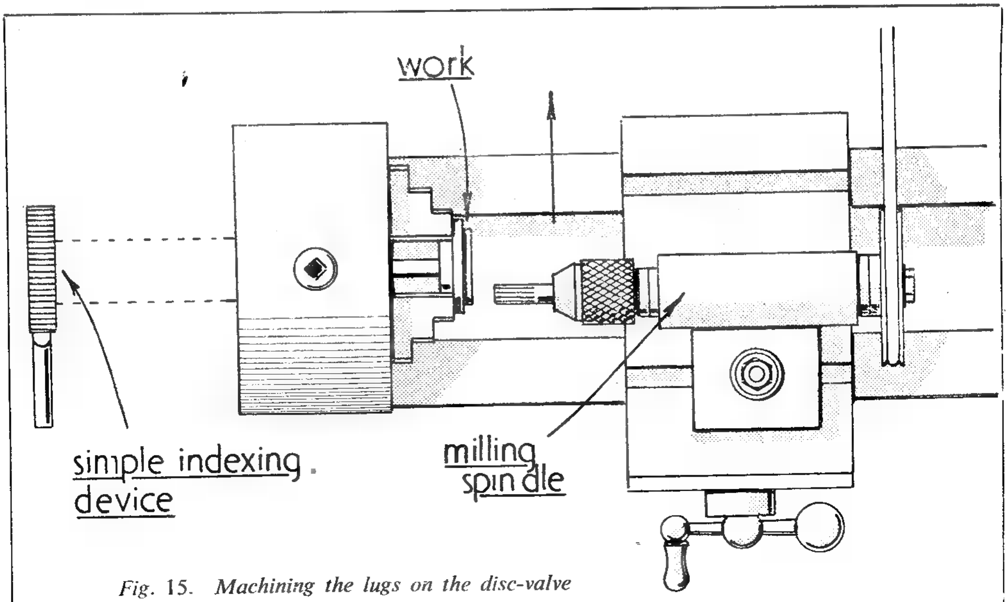


Fig. 15. *Machining the lugs on the disc-valve*

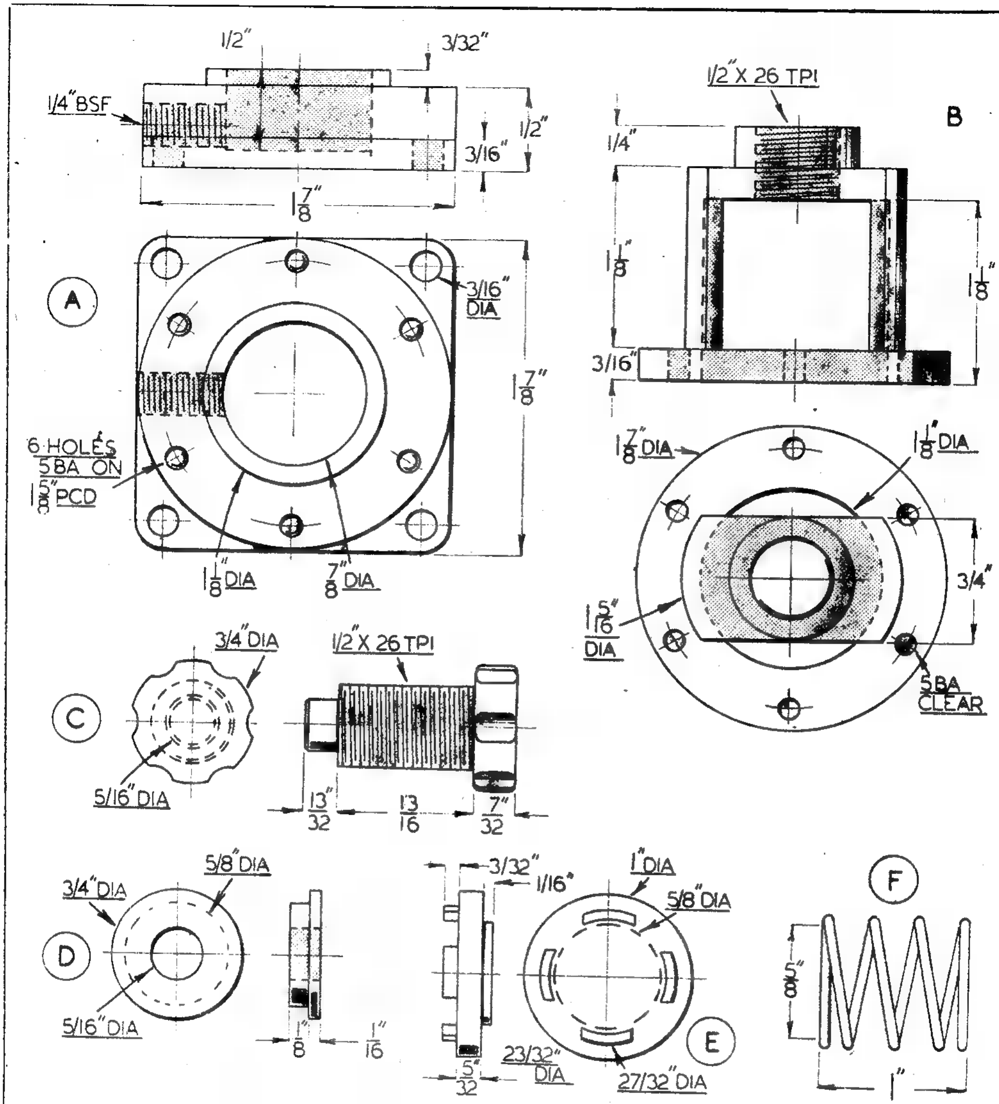


Fig. 14. Parts of the safety-valve. (A) The base ; (B) The cover ; (C) The adjusting screw ; (D) The spring collet ; (E) The disc valve ; (F) The spring

Fitting a Drain Tap to a Lathe

To fit ■ drain tap or plug on the lathe chip pan, many of us do not take kindly to drilling the tray itself. To get over this, the actual drain hole can be drilled in one of the leg-securing studs, the latter is then tapped for ■ small screw-in cock. This method does preserve the tray in its original condition.

HAROLD V. EDDY.

PETROL ENGINE TOPICS

*"New Engines for Old!"

How [redacted] Ancient Gas Engine [redacted] Improved, Modernised, and Given [redacted] New Lease of Life

by Edgar T. Westbury

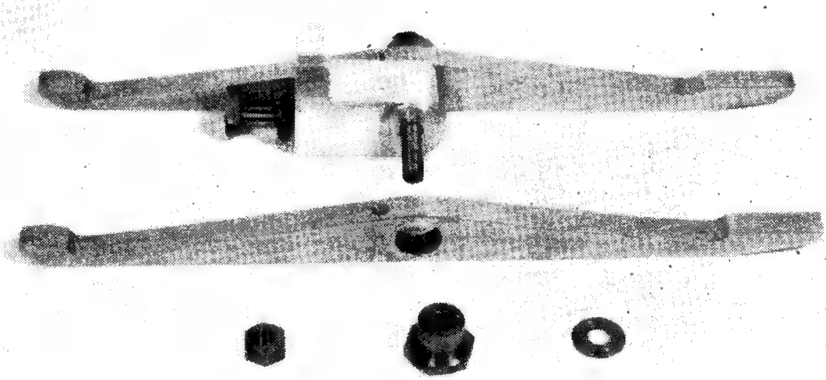
ALTHOUGH this engine was originaly intended to run on gas, and has been described throughout as [redacted] gas engine, it should be pointed out that, in common with most small internal combustion engines, its general structure and design are suited to working either on gaseous or liquid fuels, provided that it is equipped with appropriate means of feeding the fuel/air mixture to the cylinder.

Either [redacted] gas mixer or [redacted] carburettor may, with equal facility, be fitted to this particular engine, which has only [redacted] single inlet valve, [redacted] used almost universally on four-stroke petrol engines of orthodox design. But gas engines more usually have variations in the arrangement of the induction system and valve gear, and for the benefit of readers who may wish to tackle the reconstruction of such engines, [redacted] brief review of these may be justified.

In engines of moderate or large size, specifically intended to run only on gas, it was usual to fit separate inlet valves for gas and air, operated simultaneously on the inlet stroke of the engine, but of different sizes, so as to produce approximately the correct mixture for good combustion. Sometimes [redacted] variable lift device was fitted to the gas-valve, controlled by a centrifugal governor, to effect what was known [redacted] "quality" (i.e., mixture strength) governing.

A more common arrangement, especially on the smaller and simpler engines, was the inertia or "hit-and-miss" governor, in which the gas-valve was opened by means of [redacted] blade or "pecker" attached to [redacted] bell-crank lever, on the other arm of which was [redacted] adjustably spring-loaded bobweight. This assembly was mounted on the rocker which operated both inlet valves. Under normal running conditions, the bell-crank lever was held rigid by the loading spring, and the gas-valve opened fully on the inlet stroke; but if the speed became excessive, the inertia of the bobweight caused it to lag, so that the bell-crank lever was deflected, and the "pecker" missed the stem of the gas-valve, so that no fuel was supplied until the speed of the engine was reduced. Some control of speed was possible by altering the tension of the loading spring. While this method was quite effective to prevent the engine racing on light load, it was hardly conducive to very close speed control or smooth, even running, and the characteristic beat of [redacted] engine so controlled could be very irritating at times—though it might have furnished inspiration to [redacted] writer of syncopated music!

As "hit-and-miss" governing is now obsolete, it is hardly necessary to describe it in greater detail, though there are still some old engines fitted with it running at the present day. It may be mentioned that petrol or paraffin engines were often similarly governed, though the method of application was, of course, different. A once popular type of American stationary engine had [redacted] trip device, operated by [redacted] centrifugal governor,

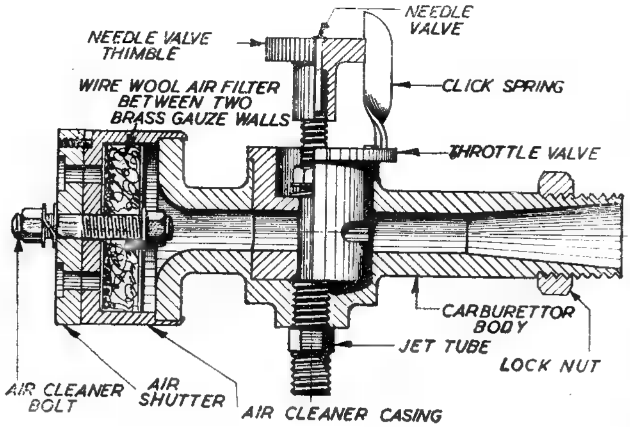


The inlet and exhaust valve rockers, with bracket, eccentric adjusting bush, locking nut and washer

**Continued from page* 244, "*M.E.*," *February* 21, 1952.

which intercepted the *exhaust*-valve push-rod and held the valve *open* if the speed became excessive!

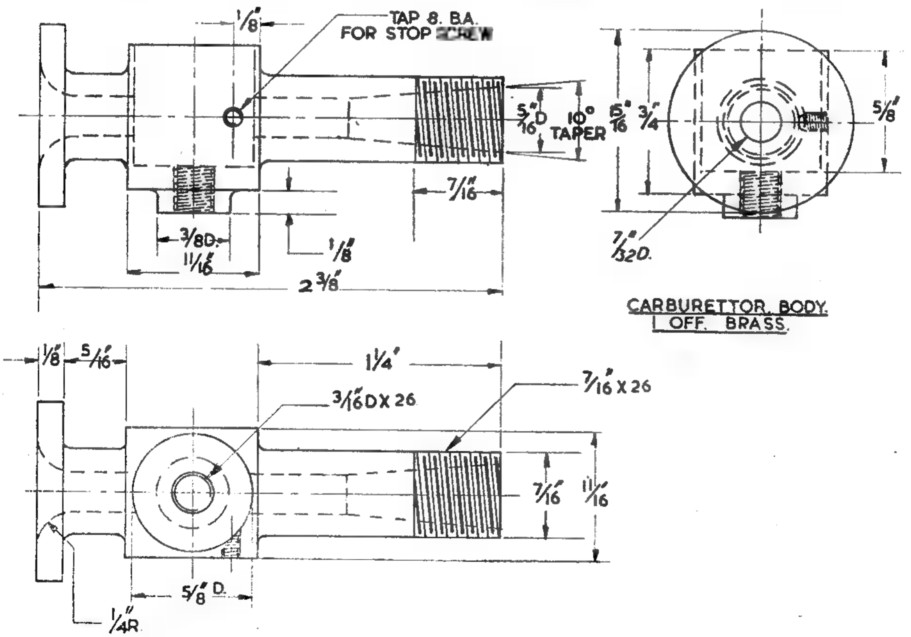
In later gas engines, both " quality " and " hit-and-miss " governing were superseded by " quantity " governing, in which both gas and air were regulated by [redacted] throttle valve or valves, actuated from a centrifugal governor. This, of course, is the method which has been used on steam engines since the days of James Watt (though other and more economical methods have since been introduced), and it is strange that it took so long to adapt such an obvious device to i.c. engines.



Sectional elevation of carburettor

The engine now under discussion was not originally fitted with a governor, and although it would not have been impossible to add one, this was not considered necessary, as the engine [redacted] to be used for experimental work rather than for long continuous running under variable load In view of the many queries on the subject of governing small engines which have been received, however, I have considered that [redacted] brief reference to the general principles is worth while.

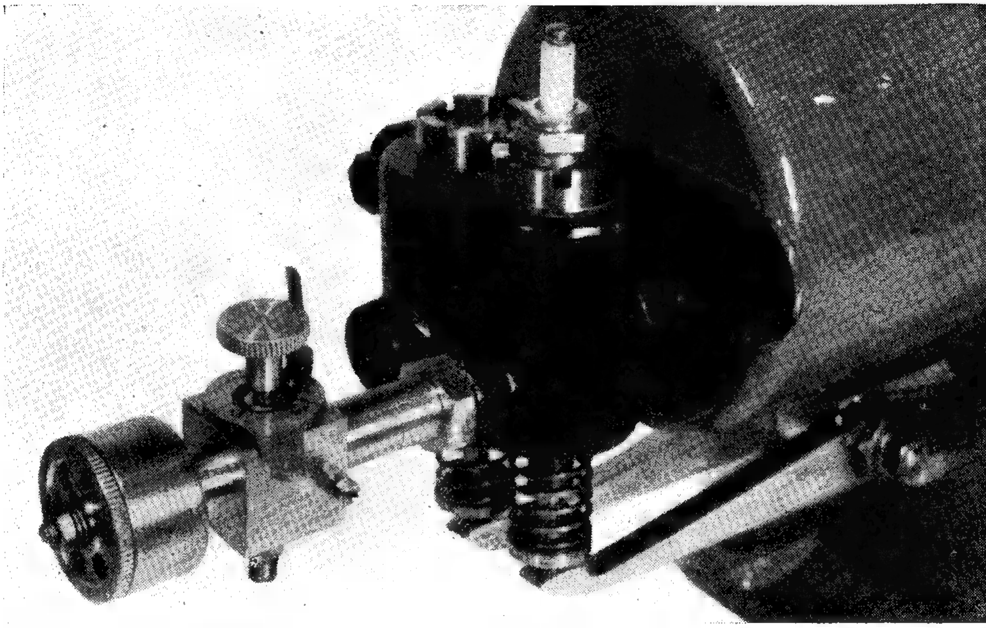
As this engine has only [redacted] single inlet-valve, the proportionate feed of gas and air is not mechanically controlled; the original mixing arrangements were very primitive, no other means of mixture control than an ordinary gas cock being provided. While it is quite possible to adjust the mixture strength by this means, to suit any given condition of load and speed, it has the great disadvantage that no automatic compensation is provided for variation of either load or speed. Starting is liable to be difficult or, at least chancy, as the inlet system may be completely filled with neat gas in the interval between turning on the gas and rotating the engine. Something better than this is highly desirable if the engine is intended to run satisfactorily and reliably on any kind of gaseous fuel, and I have in the past described gas-mixing devices of a simple nature which produce the desired results. I find, however, that few people seem to be interested in running small engines on gas nowadays, and for this and several other reasons, it was decided to fit the engine



CARBURETTOR BODY. 1 OFF. BRASS.

with a carburettor to run on liquid fuel.

It may be observed here that engines generally develop a somewhat higher power on liquid fuel than on gas, due not only to the higher calorific value of the former, but also to the fact that the atomised spray takes up less of the available cylinder space than gas, and thus enables more atmospheric oxygen to be taken in for combustion. In the matter of fuel cost, however, the advantage is usually with gas, though this may be subject to local conditions. When an engine is permanently installed, and gas supply is readily to hand, it may be the more convenient fuel; but where these conditions do not apply, or if the engine is required to be portable, liquid fuel may be the most suitable or even the only practicable fuel.



Cylinder end view of engine, showing carburettor and air cleaner

The Carburettor

Almost any type of carburettor which has been used on small i.c. engines could be adapted to work satisfactorily on this engine, within its normal limitations, and indeed the first tests of the engine when assembled were carried out with a simple carburettor borrowed from a 15 c.c. two-stroke engine. Some users, who require an engine to run at only one speed and load, may not find the need for anything more elaborate than this; but the unenviable reputation held by small i.c. engines is largely due to their lack of flexibility or ready means of control, and I have always had a bee in my bonnet on this particular subject, because I know that these engines, and particularly those which do not have to be "super-tuned" for racing, can be made as docile as a lamb if one will only take a little trouble with the design and adjustment of the carburettor.

In this particular case, carburation is relatively simple, and several of the carburettors I have described in the past could be used with little or no alteration. The use of a float chamber is hardly necessary, and the simplest arrangement of fuel supply is to locate the fuel tank below the level of the jet and feed by suction. Mechanical compensation, by means of a suitably shaped throttle valve, is quite adequate, having proved satisfactory for the more exacting demands on such engines as the "Kiwi," "Phoenix," and "Seal." There are no really original features in the carburettor shown, all the principles having thus been fully tested out in previous designs, and it is hardly necessary to state that it was an instant success on the engine under discussion.

In common with the earlier carburettors working on the same principle, the jet orifice of this one is located so that its output is influenced by the action of the throttle barrel; in this case, it is exactly in the centre of the barrel, which controls both the intake and discharge sides of the air passage, so that the pressure and velocity of air flow in the immediate vicinity of the jet tend to remain fairly constant at any position of throttle opening (I use the word "tend" because there are influences which prevent ideal theoretical conceptions working out exactly in practice, in all devices of this nature). On the face of it, therefore, the jet orifice, once adjusted, should deliver fuel at the same rate, whether the throttle is fully open, or nearly closed. This, however, is not what is wanted, because if less air is allowed to flow through the passage, the amount of fuel must obviously be reduced in the same proportion, if a correct air/fuel ratio is to be maintained.

This carburettor differs from other mechani-

cally-compensated types which I have described, in the method by which this discrepancy is adjusted. In the "Kiwi" and "Phoenix" types, the barrel was cut away on the intake side so that its rate of closing did not correspond with that on the discharge side; the "Seal" type had a permanent primary air orifice which remained open at all throttle settings. In the present example, the jet adjustment is coupled to the throttle in such a way that the jet opening is increased in proportion to that of the air passage. This is done by attaching the "click" spring, which normally locks the needle-valve thimble against inadvertent movement, to the rim of the throttle barrel, so that rotation of the latter carries the thimble with it. In this way, it is possible to adjust the needle by hand in the usual way, to find the initial mixture setting, but the throttle controls the setting for varying speeds.

As the throttle valve is intended for direct hand operation, without additional levers or linkage, it is provided with a friction lock, in the form of a spring washer, held down by a nut on the jet tube, a recess being formed in the barrel so that the nut and washer are well out of the way of the jet adjusting thimble. To limit the rotational movement of the throttle, a notch is formed in the discharge edge of the barrel, to engage a stop-screw fitted to the body; this screw also acts as an adjustable slow running stop by extending into the passage to abut against the opposite side of the barrel aperture when it is almost closed.

An air shutter is fitted to the intake to act as a choke, and thereby assist starting from cold—not as a running control—and a further refinement is an air filter consisting of a wad of steel wool sandwiched between two discs of gauze. This is kept damped with engine oil when in use. Although few small engines have this provision, it is by no means an insignificant advantage on any engine which may possibly have to work among dust or grit, such as often encountered in a small workshop.

Carburettor Body

This was turned from solid round brass bar, 1 in. diameter, but a casting would be more economical in material, and could be made in aluminium or any other convenient metal. The length of this component is rather unusual, and it could have been made much shorter, but the object was to avoid excessive heat conduction from the valve chamber, and also to bring the jet tube into a convenient position for direct feed from the tank underneath. Some readers may be surprised to note the small size of the air passage, which is only 7/32 in. diameter, and further obstructed by the jet tube where it passes through the barrel; but it has proved large enough to pass all the air required for full load working, and it is undesirable to have an unnecessarily large air passage. A high air velocity at the lowest working speed is essential in any engine which is required to be controllable; and if the speed of the engine is not high under any conditions, a large air passage will not serve any useful purpose. Many i.c. engine constructors work on the principle of making the air passage as large as the engine will take, with the result that good carburation can only be obtained when it is running flat out.

The external turning of the body was carried out at one setting, including facing the front and back of the throttle chamber, and the inside of the intake flange; also, the drilling of the centre hole, the tapered mouth of which was formed by a D-bit which I keep specially for use on carburettor bores. After screwing the end with a tailstock die holder, the work was parted off and reversed in the chuck for facing the outside of the flange and flaring the mouth of the intake, which was done with a hand turning tool. The body was then held across the jaws of the four-jaw chuck, with aluminium pads over the ends to prevent bruising, and the throttle chamber centred for facing and boring. It is important that the axis of this bore should intersect that of the main passage as exactly as possible, as this influences the compensating effect of the throttle; an offset would result in altering the relative closing rates of the intake and discharge ports.

It was found desirable to drill and bore the main chamber first and afterwards re-centre-drill the bottom of the recess for drilling and tapping the lower hole, to avoid the risk of the drill being thrown off centre when passing across the main passage. A smooth, parallel bore was machined to enable the throttle barrel to work smoothly, but final fitting was carried out by lapping.

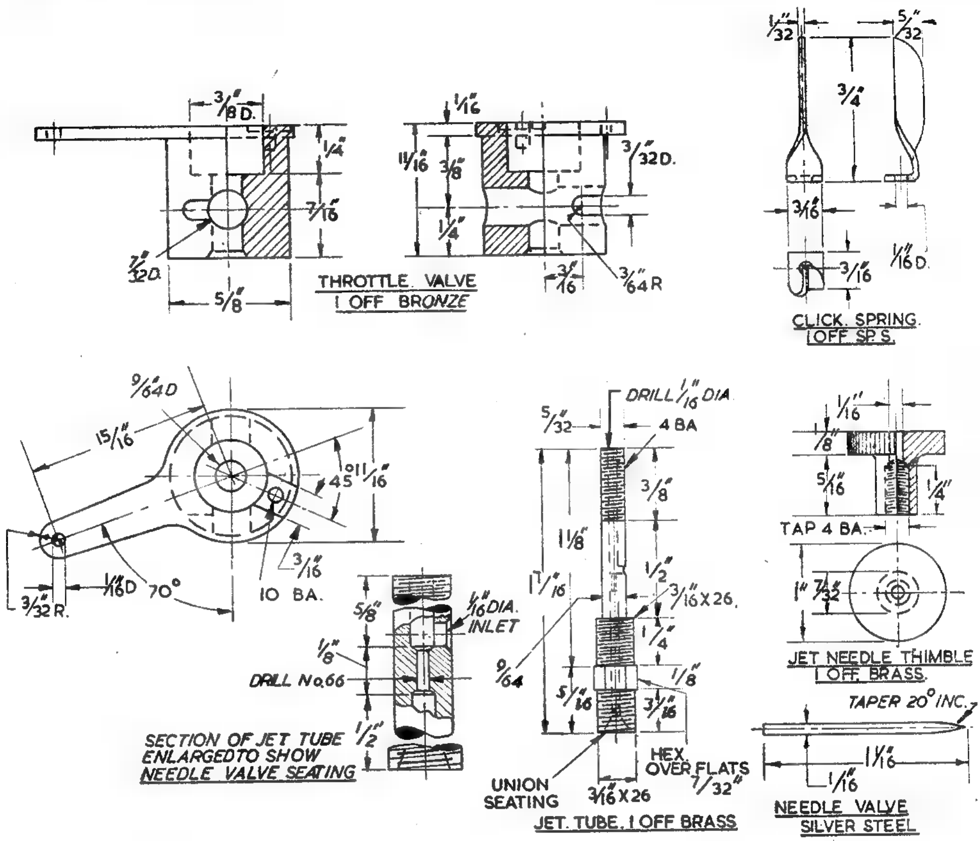
The external turning of the lower face and boss of the chamber was carried out by turning a plug mandrel and wringing the chamber on it. To face the sides of the chamber, filing or milling would be practicable, but it was carried out by mounting the body on an angle-plate attached to the faceplate using a single $\frac{3}{16}$-in. bolt through the centre, the intake flange resting against the angle-plate. The sides were squared up by means of a small square against the top face of the chamber. After dealing with both sides, all that remained to be done on this component was the drilling and tapping of the hole for the stop-screw.

Throttle Valve

This item was built up by screwing and soft-soldering, but could be made from the solid or from a casting. It should be of harder material than the body, at least on the working portion, but steel, other than stainless steel, is undesirable because of the risk of corrosion. It was turned to a wringing fit in the bore of the chamber, and inserted in place for spotting the position of the cross-hole by running in a 7/32 in. drill from either end. On previous occasions I have recommended drilling the barrel *in situ*, but the disadvantage of this, especially when a bronze barrel is used, is that it raises a burr on the edges of the bore, which makes the barrel difficult to remove, and may score the inside of the chamber badly. The position of the notch in the edge of the barrel was located by running a No. 49 drill in the tapping hole, and, after removing the barrel, this notch was milled to shape.

All this work was done before the barrel was parted off from its parent bar, as this made

handling easier, especially in the final fitting and lapping to [redacted] smooth working fit in the chamber. It was then parted off and the recess counterbored; the tapping hole for the click spring screw was drilled, and [redacted] seating recess milled to fit the spring, so that it cannot turn when screwed down. This is very desirable, as only one screw and applied *by hand* to the rotating work; in this way, its cutting action could be felt, and any tendency for it to jam or run out of truth detected. In this way it was fed in for about $\frac{1}{8}$ in. beyond the base of the previous hole. The external finishing of the tube, including screwing on two diameters with the tailstock die holder, was then



Group of carburettor components

can be used to hold the spring, unless it is made with [redacted] specially wide base, which entails a good deal more work.

Jet Tube

This called for some care in the slender external turning, and the concentric drilling of the fine orifice. The procedure for this was as follows:—after roughing down the outside, above the hexagon, to within [redacted] few " thous " of finished size, the end was centre-drilled and followed up with [redacted] $\frac{1}{16}$-in. drill to the required depth. Care was taken to see that this drill was not only sharp, but also had a fine point (a little attention with [redacted] fine honing slip was necessary), and with the lathe at top speed, it was fed in gently, and frequently backed out to clear the chips. This prevented it being forced out of truth.

A No. 66 drill was then held in a pin chuck carried out, and the job parted off to correct length.

A piece of brass bar was then held in the chuck and drilled 9/64 in. diameter for [redacted] depth of $\frac{1}{2}$ in., and No. 32 for [redacted] further $\frac{1}{2}$ in., with due care to keep the holes exactly concentric. A 4-B.A. tap was then run through, forming [redacted] seating in which the jet tube [redacted] held for turning, drilling and screwing the lower end. Care was taken to drill only just far enough to meet the No. 66 orifice, or the latter might have been drilled away, spoiling the job completely. The union nipple seating was formed with [redacted] centre-drill. Before drilling the discharge hole in the side of the tube, immediately above the jet orifice, the tube was screwed fully home in the base of the throttle chamber, in order to locate the position of the hole, facing the discharge end of the passage.

(*To be continued*)

The M.P.B.A. Club Championship, 1951

by J. H. Benson

ONCE again the committee of the M.P.B.A. has tackled the difficult job of deciding the winners of the club championship, and for the 1951 competition the Victoria M.S.C. were successful.

The results are calculated on all regattas of which information has been sent in, but unfortunately there are still one or two clubs that have failed to send entry lists of their regattas.

The table is based on fifteen regattas of which full details were available, and shows some of the most interesting scores. It will be seen that the Victoria Club has collected no less than 953 points with a very fair average per entry. They have made a fine club effort to attain this high score, and the hon. secretary, Mr. J. B. Skingley, worked very hard to attain a good representation at as many regattas as possible.

Of the provincial clubs, Bournville has been one of the most active and have attained their best effort so far. They were represented at ten regattas during the season, and their boats have been well to the fore.

Club members often ask how their particular club has fared in the competition, but this is difficult to state precisely owing to the present system whereby several factors are taken into account. In the article on the 1950 Club Championship it was stated that a *club* effort was the desired aim, and this still stands.

There are certain shortcomings in the present system of awarding points and this has been discussed by the committee, but without reaching any definite decisions.

Suggestions have been made that members attending long-distance regattas should be awarded more points than those attending a home event ; and it has also been pointed out that perhaps Southern clubs have greater opportunities, as there are many regattas held at venue around the London area.

The present scheme was based on full-size outboard racing whereby a competitor scores a point if he completes a race, 15 extra points for a win, 10 extra for second and 5 extra for third respectively. This is a watertight plan for *individuals* since it is only necessary to add up the total of points at the end of the season in order to find the winner.

In inter-club regattas held under the auspices of the M.P.B.A., certain events only rank for points—steering and nomination events, and races in the established speed classes. Club secretaries are requested to make a copy of the competitors and placings at their regattas and forward them to the M.P.B.A. after the regatta.

The hon. assistant secretary, Mr. A. A. Rayman, does all the work involved in the tabulating and analysing of the various results, and all clubs are asked to co-operate during 1952 so that his task may not be hampered by failure to obtain these entry lists.

Needless to say, the committee of the M.P.B.A. would welcome suggestions from clubs or individual members for improving and modifying the " points scheme."

It is pleasant to notice that regatta attendances are increasing in recent years, and there is no doubt that the model power boat movement is steadily growing as an active hobby. This is largely due to the happy combination of the constructional, the competitive and social sides of model engineering.

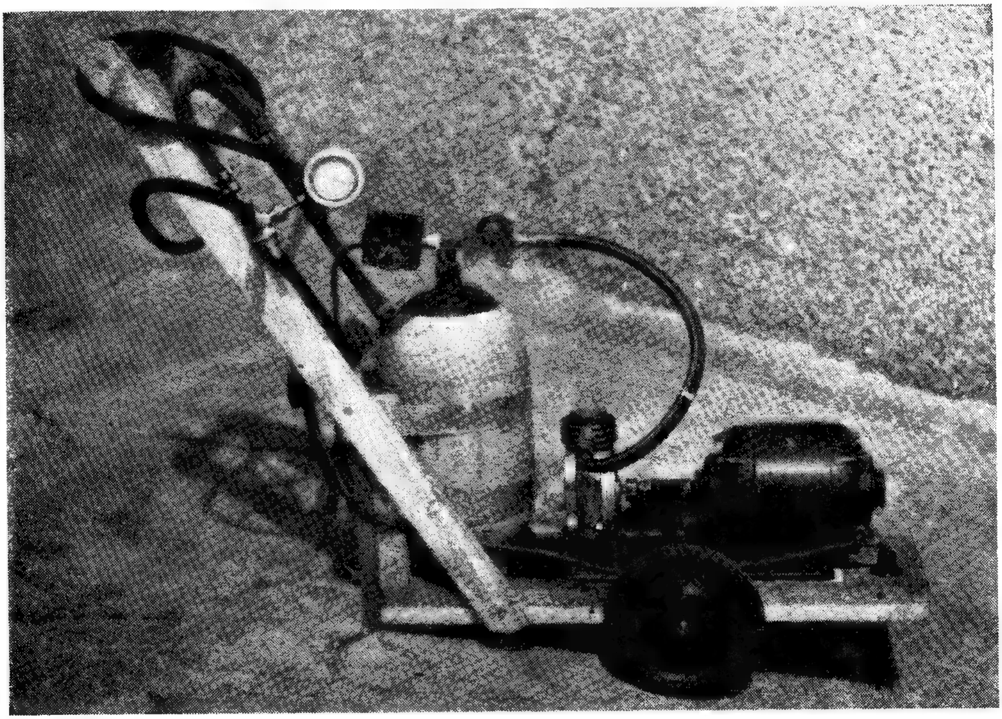
LEADING SCORES FOR 1951

Club	Regattas attended	Total of events entered	Points scored	Average number of points per entry	Total different craft at regattas
Bedford	5	28	50	1.8	7
Blackheath	15	175	446	2.54	21
Bournville	10	47	227	4.83	14
Cheltenham	3	18	59	3.26	[illegible]
Croydon	13	32	37	1.03	3
Enfield	12	44	264	6.0	9
Guildford	8	8	71	8.87	1
Kingsmere	16	145	443	3.06	24
N. London	5	14	28	2.0	3
Orpington	13	59	256	4.33	8
Runcorn	4	10	72	7.2	4
S. London	12	35	158	4.51	6
Southend	3	36	97	2.69	9
St. Albans	3	17	36	2.11	4
Swindon	5	14	33	2.37	3
Victoria	16	281	953	3.39	46
W. London	5	39	35	0.9	13

Conversion of an Ex-R.A.F. BTH Compressor

by Robert Cutler, M.R.C.S., L.R.C.P.

MOST model makers, handymen, and car owners (some of us are all three), must have noted with interest advertisements of this fitting in the pages of THE MODEL ENGINEER, and the following details of the primary installation may give guidance to fellow readers. As a preliminary, and to save later dissatisfaction, one-third horse power, 1,425 r.p.m. motor, proves excellent for tyre pumping, small home spray work for either paint, insecticide, and penetrating oils for motor car work, and if a reservoir air bottle is incorporated with cut-off taps, really high pressure jet clearing of swarf and dust from inaccessible places is possible.



Trolley mounting of compressor arranged for axial drive

some general points in regard to compressors may be of value, the practical factor being the number of cubic feet of air passed per minute under normal working conditions; thus a large slow-speed compressor, powered by, say, a 1 h.p. motor, may only pump up to, say, 60 or 80 p.s.i. before "blow past" occurs, but will maintain a constant pressure of say 40 p.s.i., at say, 3 c.f.m., rendering it suitable for use with a commercial spray gun, small pneumatic tools, etc. At the other extreme, small precision-made compressors (like the unit now to be described) will pump up to 200 p.s.i. before "blow past" occurs, but the c.f.m. passed may be as low as $\frac{1}{2}$ or $\frac{3}{4}$, unless the driving speed and power conditions are unduly high; sufficient to say, however, that this unit, powered by a

The above details refer to piston-type compressors and are to be distinguished from fan-bladed units such as the Roots type blower used for petrol engine supercharging, and the domestic vacuum cleaner, which pass a relatively high amount of air at low pressure, usually measured in water gauge inches and rarely exceeding 20 p.s.i. even for the most powerful aero engine supercharger.

The compressor as advertised is beautifully made, with clockwise rotation for the single-ended spigot shaft, the valve being within the detachable hexagon head which need not be disturbed (Fig. 1). The air inlet and oil filter orifice extends from the crank-case opposite the outlet pipe (screwed $\frac{1}{4}$ in. B.S.P.) the air inlet having a disc inlet-valve preventing blow back

or admission of dust through the inlet holes when the unit is not in operation. There are six bolt holes 9/32 in. diameter spaced around the crank-case, the lowest two being used in the suggested set-up. A hexagon head drain plug is at the bottom of the crank-case. Quite obviously the unit was made for bolting to the main engine crank-case, the drive being taken *via* a relatively narrow splined shaft (Fig. 2), recessed near the self-sealing ball-bearing housing, so any question of pulley drive is inadvisable unless the outer end of the shaft is also supported in a bearing. (The writer made such an assembly but soon discarded it for the axial drive now to be described.) After preliminary experiments, direct shaft drive was planned utilising a one-third horse power a.c. motor, 1,425 r.p.m. with $\frac{5}{8}$ in. shaft, clockwise rotation, and as a fairly considerable starting torque is necessary, the capability of the motor in this connection must be checked.

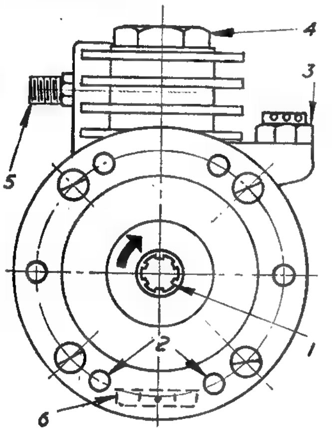


FIG. 1.

(1) *Single-end shaft, clockwise rotation* ; (2) *9/32 in. bolt holes for fixing to angle-iron base* ; (3) *Oil filler and inlet filter-valve cap* ; (4) *Detachable head : do not disturb* ; (5) *Outlet screwed* $\frac{1}{4}$ *in. B.S.P.* ; (6) *Drain plug*

Conversion of the splined shaft assembly consisted in taking a $\frac{5}{8}$ in. diameter mild-steel hexagon-head bolt (Fig. 3), and sawing off to leave a shank $1\frac{1}{4}$ in. long below the head. It is chucked in the three-jaw leaving the head projecting, and then centre drilled, a pilot hole, 2 B.A. or $\frac{3}{16}$-in. Whitworth tapping size, being drilled right through ; this is enlarged to $\frac{1}{2}$ in. diameter to a depth of $1\frac{1}{4}$ in. from top of hexagon head and this latter is then recessed to 0.96 in. diameter, $\frac{5}{16}$ in. deep to form a close fit (almost a driving fit) on the shoulder of the compressor shaft. A 2 B.A. tapping hole is drilled through the hexagon head across the flats, and the bolt lightly pushed into position, the recessed portion of the hexagon head fitting snugly over the shoulder of the shaft ; using the head holes as a jig, shallow indentations are drilled through on to the shaft shoulder, a register mark made, and the bolt withdrawn. The hexagon-head holes and the remainder of the pilot hole are tapped $\frac{3}{16}$ in Whitworth or 2 B.A. The bolt is then replaced according to the register mark, and set-screws or Allen screws lightly engaged in the indentations on the shaft shoulder. A conical-ended set-screw is then screwed in from the end of the bolt shank, until its point is felt to engage the centre drilled hole in the end face of the spline, when it is screwed little more than finger tight, and locked with a hexagon lock-nut, the projecting stem being sawn off flush. This centralises the bolt, and the main head set-screws are then locked solid. If the bolt was drilled out to 0.49 in. diameter with a specially made D-bit drill, the centralising pin

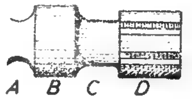


FIG. 2.

" *A* " *and* " *C* "— 0.355 in. *dia* ; " *B* " — 0.56 *in. dia.*, " *D* "— 0.49 in. dia.

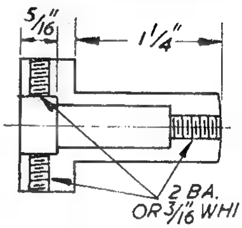


FIG. 3.

would not be necessary, as this is the diameter across the splines of the shaft, and is its effective diameter, but the method described produces a truly concentric and firm shaft. To mount the unit, two 6 in. lengths of 2-in. angle-iron are cut and drilled and the unit secured between, with 9/32-in. bolts, careful fitting being essential to secure a true base for the angle-irons. Motor and compressor assembly are then set-up on a thick wood baseboard, and shafts accurately aligned with about $\frac{1}{4}$ in. between the ends of the shafts, and either compressor or motor screwed down permanently. A length of fabric reinforced radiator rubber hose $\frac{5}{8}$ in. bore, is then procured with appropriate size jubilee clips, and this is then pushed over the shaft of whichever unit has been fixed. The other unit shaft is then pushed into the rubber coupling and secured by its appropriate clip (Fig. 4) ; this form of drive proves excellent, as there is a slight

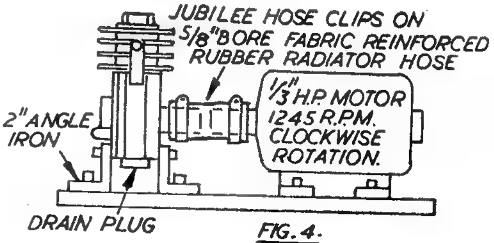


FIG. 4.

torsional effect on starting, the further the jubilee clips being apart the greater the reduction in the starting load of the motor. Plain rubber hose pipe or garden hose clips are not recommended if the motor is to be run for long periods.

Before the first run, the crank-case *must* be filled with light oil, castor oil, or compressor oil through the inlet filler cap previously des-

(*Continued on page* 320)

CORRESPONDENTS AHOY!

by "L.B.S.C."

IN a recent issue, I mentioned that it was a physical impossibility to send fully-detailed replies to correspondents' queries, so I now propose to deal here with a few of the questions recently received, in the hope that it may save both their time and my own. The trouble principally arises from the fact that not only do querists want information on how to deal with a certain job, but they want to know all the whys and wherefores as well—quite commendable; a thirst for information is a good sign, but the unfortunate part about it is that it cannot be satisfied in the easy manner associated with another kind of thirst. Did I hear somebody say: "What about a quick one?" Anyway, let us get down to brass tacks—the "quick one" can wait until we have finished.

A "Minx" meets a Jinx

Bad Steaming Troubles

A reader wrote that his engine was a bad steamer. She got up steam quickly enough, but as soon as she started to pull hard, down went the pressure. I told him to look for all the usual troubles—air leaks in smokebox, blastpipe nozzle too big, or not correct height, choking of tubes, faulty ashpan arrangements, and all the rest of the usual causes of shy steaming. He said that everything was in order, but he had made an alteration to the grate, on the advice of our old friend the club member who doesn't build engines himself, but nevertheless knows all the answers. This unworthy had criticised the size of the blast nozzle, and the spacing of the firebars, saying that the latter were much too close; they retarded the flow of air, and if spaced a lot wider, a larger blast nozzle could be used, as it would need less draught to pull the air through the wider spaces.

It was the querist's first engine; he was a newcomer to the club, at the time, and was impressed by the apparent wisdom of Mr. Knowitall, so he used $\frac{1}{8}$ in. bars spaced nearly $\frac{1}{4}$ in. apart, and made his blast nozzle several drill sizes larger than specified. The first time he got up steam, the engine was a complete flop, as the fire refused to burn brightly at all. He realised right away, that he hadn't sufficient draught, and made a new blast nozzle to specification, which improved matters; but the fire still burned patchy, and he couldn't keep steam pressure high enough for continuous running, also the ashpan rapidly filled up with cinders.

Too Much of a Good Thing

To cut a long story short, the trouble was simply due to the wide spacing of the firebars. Now if you take a look at the grate of a full-sized engine, or a drawing of same, you'll see that the total area of the tops of the firebars is

greater than the area of the air spaces. That is to say, more of the actual grate area is blocked up, than is left open. Now in my locomotive-boiler experimenting, I have tried all sorts of combinations of bars and spacing; and allowing for the difference in the size of the firebox, and the speed at which the blast draws the air through the fire, I found that a shade more air space than bar space gives the best results under normal working conditions. This resulted in practically "standardising" bars $\frac{1}{8}$ in. thick, with $\frac{1}{8}$ in. air spaces, for all normal engines; the little bit extra being accounted for by virtue of the number of air spaces always exceeding the bars by one—eh? No mistake at all; there is an air space between each outer bar and the firebox; work it out for yourself! Also, there is a small gap between the ends of the bars, and the tube and door sheets of the firebox. Air is good for the fire, but you can have too much of it!

Weeny fireboxes like *Tich's*, the huge caverns like *Pamela's*, and the intermediates like *Doris's* all have the same width of bars and spacing, although the depth of the bars varies with the size of the grate. If the bars are shallow on a big grate, they will sag in the middle; I had that trouble with the first grate fitted to the *Caterpillar*. Later, I fitted an experimental grate with 3/32-in. bars and $\frac{1}{8}$ in. air spaces; the bars were nearly $\frac{3}{8}$ in. deep. They didn't sag, but they eventually burnt away in the middle. The grate she now has, was cast by Wilwau's son Billy. It has $\frac{1}{8}$ in. bars and $\frac{1}{8}$ in. spaces, but the bars taper from the surface to the underside, so that anything that gets through, promptly falls direct into the ashpan, and doesn't lodge between the bars and block up the airways. The fire keeps very clean, and the engine steams wonderfully well on a very thin fire. For new readers' benefit, I'll repeat that she is a four-cylinder 4-12-2 with 135 deg. cranks, and purrs instead of puffs. *Jeanie Deans's* grate has $\frac{1}{8}$-in. bars and $\frac{1}{8}$ in. spaces, and she steams like a witch; a direct refutation of Mr. Knowitall's dictum that widely-spaced bars are required for moderate blast, because she hasn't any blast worth writing home about. Indeed, one party who saw her working, said if the exhaust was any fainter, it would fall down in the smokebox instead of going up the chimney! In our correspondent's case, the wide spacing of the bars allowed so much air to go through the fire, that the coal wasn't all burnt; and the rush of cold air, especially around the edges of the grate, just tended to cool the firebox plates instead of heating them. A new grate, made as per words and music, completely cured the bad steaming, and the locomotive now performs as intended and expected.

Another Example of Plate Cooling

Another reader built a $2\frac{1}{2}$-in. gauge engine with a narrow firebox, and was troubled by bad steaming. He assured me that the job was built exactly to specification; the chassis did wonders on air test, the boiler raised steam all right, everything seemed in order, but the pressure dropped on the road. He was quite convinced that the firebox wasn't large enough; other people had told him so, and he had read in a book that the largest possible amount of grate area was required. Ah, said your humble servant, but HAD he built the engine EXACTLY to specification—not made some so-called "improvement," or modification, of his own, or to other folk's admonitions? Well, yes, he had; but merely in two small points, which were insignificant. Not liking the personal appearance of clacks on the side of the boiler, he had put his clacks on the backhead, in the only clear space available, under the firehole door; and as he though that the feed pump was on the small side, he had made the ram $\frac{3}{8}$ in. diameter, instead of the specified $\frac{5}{16}$ in. He was assured that these alterations would make no difference.

Face to Face!

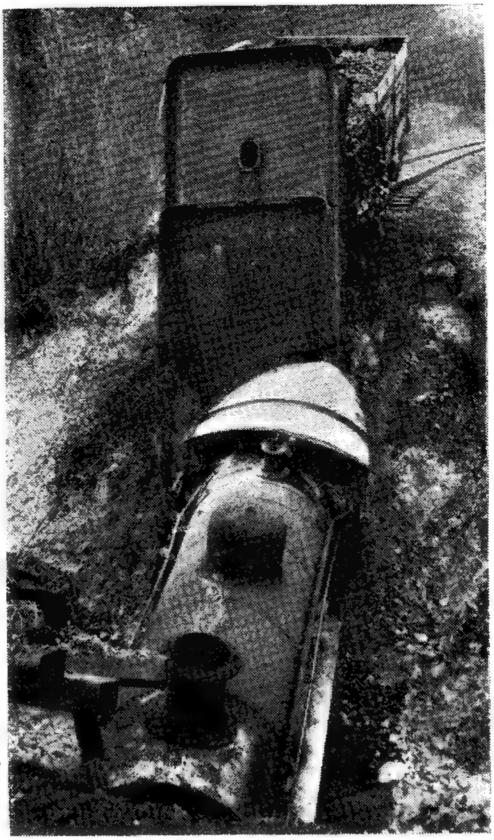
There was his trouble—staring him right in the face! He had not only put his clacks in the worst possible position that could be imagined, but had "added insult to injury," in a manner of speaking, by increasing the flow of stone-cold water on to the most valuable part of the heating surface of the whole boiler; viz. the firebox plates. Even the veriest Billy Muggins should be able to realise that you can't squirt a continuous torrent of cold water against a hot copper plate without cooling it! The only admissible feeds, on the backhead of a locomotive boiler, which are consistent with good efficient steaming, are firstly, an injector feed which is delivered hot, by virtue of the jet of steam condensed in it; and the feed from the emergency hand pump, which is, as its name implies, only used intermittently in emergency, and never when running. Even these should, in no circumstances, deliver below the firehole door, but should be placed well up; right on top of the firebox wrapper, is the best place. Those of my own engines, which have the hand pump delivery on the backhead, are being converted to top feed, by a very simple process. I leave the clack where it is, but block up the outlet to the boiler. In place of the ordinary cap, I substitute a union cap, exactly as specified for the clack on the end of the injector. A pipe is taken from this, to an elbow screwed into the top of the wrapper. There is a twofold advantage in this; not only does the water enter at a better place, if there is occasion to use the hand pump, but if the engine is turned upside down, for any reason, and the clack ball comes off the seating, there is no loss of water when the engine is turned right way up again.

I recommended this alteration, to the correspondent referred to; also told him to bush the pump barrel to correct size, turn the ram to suit, and fit a new gland nut. The recommendations were adopted, and pressure is now easily maintained on the run, when the pump is feeding.

Unexpected!

A friend whose locomotive has one of my injectors on it (present for "services rendered") happened on an unusual spot of bother, which may save a query if I relate it. The injector when working apparently O.K. would suddenly knock off, and start to blow steam from the overflow, especially when the water was low in the tank. My friend thought maybe it wanted

cleaning, and was going to take it off, when he noticed there was a "fillet" of water showing around the valve spindle where it entered the gland of the injector water valve, which projects above the tender footplate; and as he was adjusting the valve, also noticed that the water disappeared into the gland nut, the injector promptly knocking off. The culprit was discovered! At one position of the valve, when nearly closed, air was being sucked in past the packing and the valve spindle; and half-a-turn of the gland nut stopped all further antics. Truly, it is the little things that matter! Beginners may be reminded that a blow at the injector steam-valve gland, will not only reduce the pressure at the steam cone and prevent the injector working properly, but may scald their fingers if not attended to!



SOS!

Putting on a Spurt

A correspondent, giving his engine a rebuild, fitted a multiple-element superheater of the kind described for *Pamela* and other engines in these notes, and says the engine steams and pulls in great style, but has developed a craze for spurting. She will be trotting along nicely; and then suddenly, without warning, she starts to try and emulate *Queen Mabel*, to the accompaniment of a miniature volley of loud exhaust beats. This only lasts a few seconds, and then she runs normally again. As she didn't act in this manner with the original two-element superheater, he reckons it must be something to do with the new one.

He is perfectly correct. What happens is that, owing to the water level being on the high side, or what the kiddies would call "sloshing about," or even because of a dirty boiler or bad water, a few drops go down the steam pipe and enter the superheater elements. They are immediately "flashed" into high-pressure steam, with the result he mentions. The old superheater didn't have sufficient heating surface to cause the water to evaporate so quickly; the only effect was to wet the steam a little, without any noticeable effect on the running. The obvious cure is to see that the water doesn't get too high in the glass, and keep the boiler clean inside.

Free Showerbath

The builder of a *Princess Marina* says that every time he opens the regulator, after a stop, or when coasting, he gets a showerbath, as the engine throws water from the chimney. When running, she is all right. Simply explained once more! The engine has a disc-in-a-tube regulator, in the top of the Belpaire firebox casing. On this engine, the tube has a series of holes drilled along the top. If the level of the water is high, or if it is "sloshing about," it is quite possible, when the regulator is closed, for the tube to get filled with water, right up to the holes; and as soon as the regulator is opened, down goes the whole blessed lot to the cylinders, to be blown out of the chimney along with the exhaust steam. Remedy obvious!

Incidentally, according to the paper on "Standard Locomotives" read before the Institution of Locomotive Engineers, by Mr. E. S. Cox, the *Britannias* have had this trouble. The gadget on top of the steam pipe in the dome, which is supposed to keep water out of the pipe, failed in its mission. The pipe filled up with water when coasting, and as soon as the driver opened up again, it doesn't need a Sherlock Holmes to deduce the consequences. As Mr. Cox explained, the relief valves on the cylinders couldn't get rid of the water, and bang went the piston. If *that* didn't give—well, something else did; and that is all there is to it!

More Whys and Wherefores

Speaking of the *Britannias*, several readers have asked why I didn't specify hollow axles, as the big engines have them. Well, it was just for this reason. Years ago, before the war, I tried a set of hollow axles. The engine seemed all O.K. with them; but for some reason, I had to take the driving wheels off; I forget exactly what it was now, something to do with the pump eccentric, as far as I can recollect. Although the wheels had been put on by pressing, in the usual way, they came off very easily, needing very little pressure indeed to get them off. I just thought that, most likely, the pressure used to squeeze the wheels home, had crushed in the wheel seats around the holes; so I just

replaced the hollow axles with solid ones, and thought no more about it. However, if friends and relations of Inspector Meticulous want to simulate the hollow axles of the full-size class "7's," press the wheels on solid axles first, and then drill shallow holes in the ends, to simulate the holes in their big sister's axles. That will avoid any crushing-in during the pressing operations.

Wet Coal?

While chinwagging about whys and wherefores, somebody wanted to know if coal burnt better when it was wetted, as he had seen several firemen spraying water on the coal in the tenders. Bless his innocent heart, they were only laying the dust, otherwise they would have been as black as the ace of spades and very nearly choked, in the first ten miles! Certain other parties, reading the more-or-less garbled account in the daily papers, of the cause of the pitch-in just south of Stowe Hill Tunnel, when the Liverpool-Euston train came off the road and went down the bank, asked what the merry dickens was meant by a few-thousandths-of-an-inch error on the part of a fitter, causing the wreck.

The explanation was simple, but beyond the understanding of the average newspaper reporter, who is an excellent fellow, but absolutely sunk at the slightest technicality. Recollect the assertion that 20 tons weight had been saved on the Southern nightmares by leaving off the running boards? Well, the bogie axles on the L.M.S. engine had been changed over, to equalise the flange wear; nothing new, or alarming, in that, [redacted] it is common practice. I've done it on my little engines. But in this case, it so happened that the erstwhile rear axleboxes were a wee bit tight in the front horns, maybe to the extent of a few thousandths; and somewhere on the curve between Weedon Station and the tunnel, one of the boxes lifted, stuck in the horns, and didn't come down again. The wheel being held clear of the rail, naturally, it came off the road, and the rest of the engine wheels followed suit, taking the train with them. Incidentally, I know the bit of road where it happened, as well as I know the road where I live, as I travelled over it six days [redacted] week for about three years. Some time after leaving the railway service, I had a job on experimental motor work in Coventry and Birmingham. I [redacted] living at Dulwich (South London) at the time, and found it cheaper to travel daily, than "lodge away"; my quarterly season-tickets worked out at over thirteen miles for a penny! Naturally I made several footplate trips, one of them being on 5000 *Coronation* (George the Fifth class 4-4-0). We knocked off the $77\frac{1}{2}$ miles Rugby to Willesden in 76 minutes, with fourteen on, including two diners. Maybe one of these days we'll have an interesting lobby chat on some incidents that happened during approximately 230,000 miles travelling over the good old London and North Western Railway.

Poor Old Minx!

Writing about [redacted] railway accident, reminds me of another spot of trouble, which happened on [redacted] bit of the old L.B. & S.C. Rly. which I knew well, as we used to run race specials over it. This was the single line between Midhurst and Chichester, long since closed to passenger traffic. In the old days, when Goodwood Races were on, the company ran plenty of specials to Singleton, the nearest station to the racecourse. Sometimes our engines would "lose their feet" and start slipping in Cocking Tunnel; and if the "lary boys" had the carriage windows down, they nearly got gassed. They always swore we did it on purpose! Anyway, the heavy rains of last November washed out [redacted] culvert near Midhurst; and a *Minx* found the soft spot and sank into it, as can be seen in the two photographs reproduced on previous pages. Luckily, the driver and fireman jumped clear, and were not injured.

When an American freight train, running on [redacted] single line, takes siding to let another train pass in the opposite direction, the enginemen call it "going into the hole." The poor old *Minx* went into the hole all right! I knew her well in the old days; she was built by the Vulcan Foundry Co. in 1900, was stationed at Battersea sheds, and bore the number 540. That will be all for the present, I must now carry on with the *Britannia* drawings—mustn't keep builders waiting too long!

Conversion of an ex-R.A.F. BTH Compressor

(*Continued from page* 316)

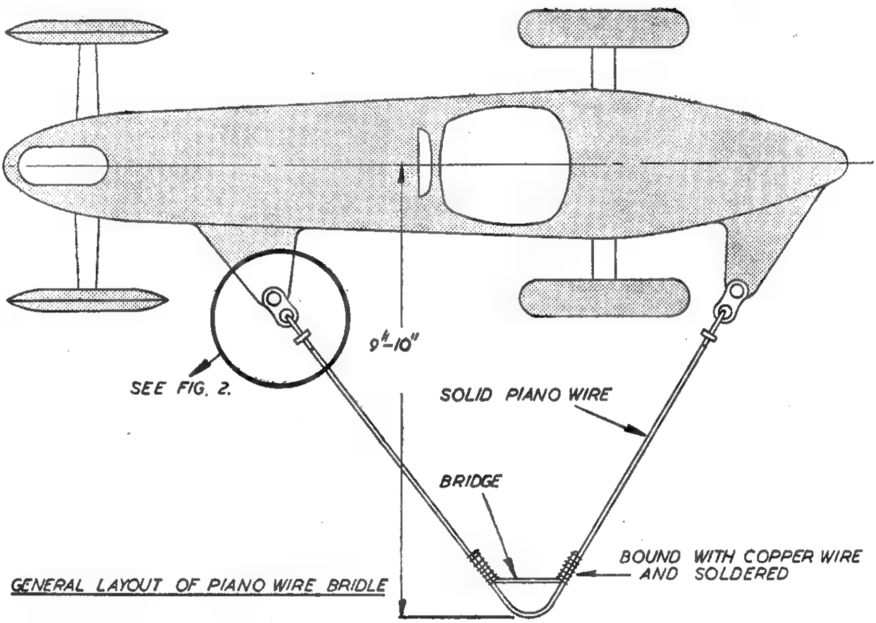
cribed, and the compressor started up with open outlet; if too much oil has been put in, the excess will be immediately squirted out.

With this unit, pressures of 100 p.s.i. in a reservoir tank can be secured easily, and as far [redacted] the writer is concerned, tyre pumping has become a positive pleasure. The writer's own unit is mounted on [redacted] wheeled trolley, with air bottle gauges, cut off taps, tyre connector cable, and auxiliary air line cable for spraying, and forms one of the most useful motorised units it would be possible to imagine.

Model Racing Car Bridles

in which modern tethering attachments are expertly discussed by "Pushstick"

FROM [redacted] number of quarters the suggestion was made that the English model car movement should reduce its standard bridle length from the original figure of 24 in. to 9 in. from centre-line of the [redacted] to the apex of the bridle, and at [redacted] M.C.A. meeting this proposal was accepted and has become standard. This brings us into line with the standard lengths used



GENERAL LAYOUT OF PIANO WIRE BRIDLE

in the United States, Sweden, South Africa, Australia and other countries where model cars are raced, and so facilitate the running of international and inter-country events, as well as making more correct comparisons between speeds obtained here and abroad. Another big point in favour of reducing the bridle to 9 in. does come into the picture when using solid piano wire, and that is that piano wire is most readily available in 36 in. lengths, which means that now the bridle can be made from one piece instead of two, and thereby reduces the number of joints or ends, which are usually the weakest points.

In the early days in this country there was an almost universal use of flexible bridles (usually "Bowden" cable or stranded wire rope about $\frac{1}{16}$ in. diameter), but more recently solid piano wire has become popular and has to a certain extent succeeded it. There are merits in both types, but it does not seem necessary to go into great detail here on the question of which type to use, since it is [redacted] matter of personal preference, so an endeavour will be made to cover the making of both types, and also the "pan-handle," which is [redacted] single rigid attachment fastened to the car at or about its centre of gravity.

Before we discuss the actual bridle, it will perhaps be as well to consider with what we have to contend. The loads exerted by centrifugal force on a car travelling fast are very considerable, and the necessity for watching the safety angle cannot be too highly stressed—and it is to be hoped that the cable will not be, either! The formula for calculating the load in the cable and bridle is to be found in any engineering text book, but for convenience may be re-quoted here :—

$$C.F. = \frac{\textit{Weight of Car (lb.)} \times \textit{Velocity}^2 \textit{ (in ft.p.s.)}}{32.2 \text{ ("G")} \times \textit{Radius of track (in ft.)}}$$

However, for the people (including myself) who dislike repeating similar calculations, the graph (Fig. 1) can be used. This covers the more common sizes of track and gives loads per lb. of car at speed up to 130 m.p.h. When using this graph, the estimated maximum speed (be [redacted]

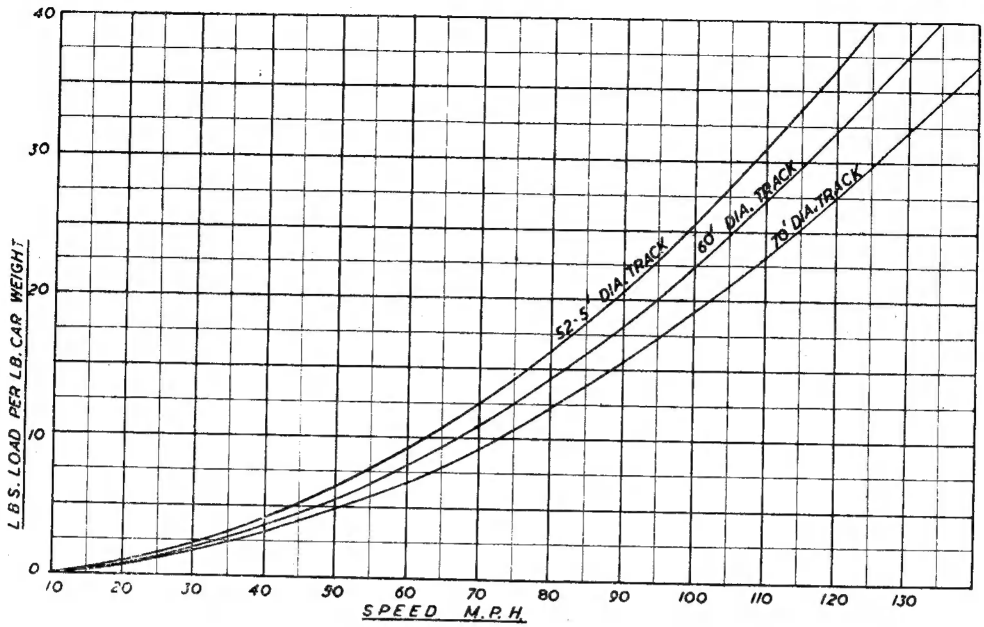


Fig. 1

bit optimistic here !) should be read along the bottom, then taking the appropriate sized track, the load can be read off on the left-hand scale. This, multiplied by the weight of the car, represents the *actual* load. When considering the

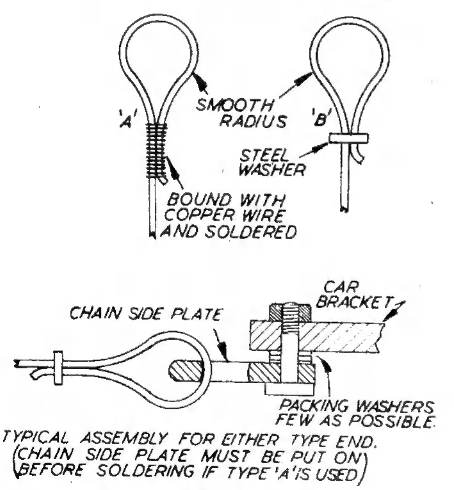


Fig. 2

strength of the bridle, this figure should be multiplied by *at least* 1½, and preferably 2, to give a safety factor to allow for snatch, reduction in strength through wear, etc. To digress for a moment, it is as well to note that concrete is extremely abrasive, and the cable to the centre pole should be examined frequently, as its strength drops rapidly after having been dragged round on the concrete when the cars are starting and stopping.

To return to the car bridle, since its strength is governed to a great extent by the care exercised when making the end loops, it isn't really very practicable to lay down any specific gauges of wire, but as a guide, the following have been found satisfactory when reasonable care has been taken in bending.

10 Class 16 s.w.g. (14 s.w.g. if for use on small track).
5 Class 18 s.w.g.
2½ Class 22 s.w.g.

These figures refer to the use of the divided bridle and if a pan-handle shorter than 9 in. is used, which will necessitate a single link being used to bring it up to length, a separate test should be made to satisfy yourself that the strength is sufficient for the particular case. It is always a good thing to conduct a few tests, as detailed later, using portions of the same length of wire, and exactly the same technique as is to be used on the actual job. Different batches of wire vary tremendously and it is useless to take the figures for one length as being representative of a different batch. Testing of the actual bridle is of dubious merit, since the testing may itself weaken it, and cause subsequent failure.

Assuming that the car is completely finished and fitted with all ignition equipment, etc., and has the fuel tank filled all ready for the track, a pattern for the bridle can now be made from either string or, preferably, soft wire such as brass, copper, or iron, which will retain its shape. Bend this roughly to shape, hook on to the car,

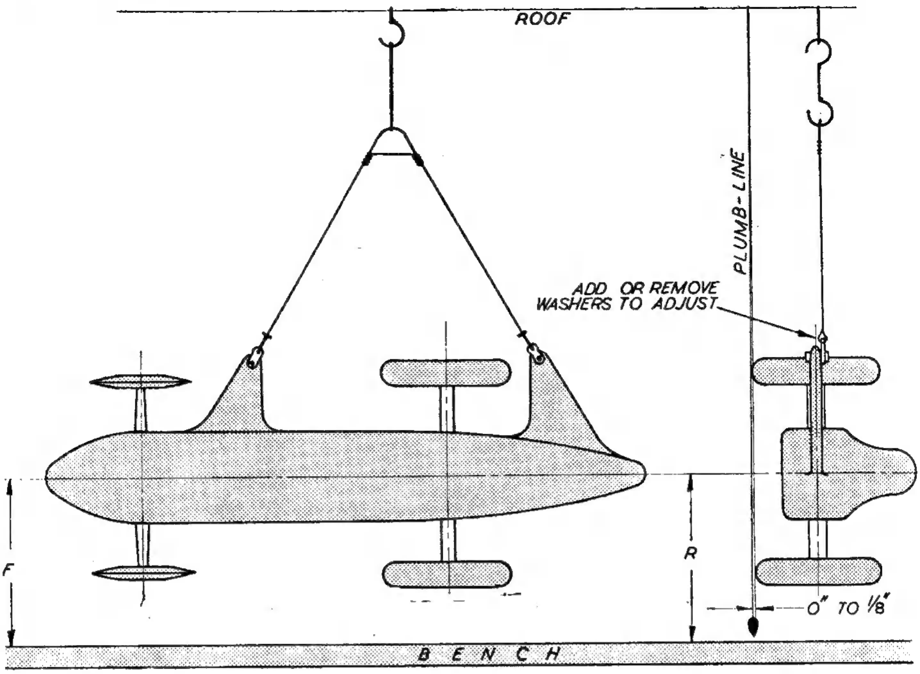


Fig. 3A. "F" and "R" to be either equal, or "F" equals R + ⅛ in. max. *Fig. 3B*

and suspend from a hook so that it is quite clear of surrounding objects (Fig. 3A). It is of assistance to mark the centre-line on the underside of the car, front and rear and measure from these down to some horizontal datum, such as the bench. The soft wire should now be adjusted so that the car hangs horizontally, or not more than about ⅛ in. nose in (nose high in this position). At the same time the figure of 9 in. should be aimed at for the distance from centre-line of car to bridle apex. This figure must not be less than 9-in., but can be up to, but not more than, 10 in. This limit should be ample for margin when making the bridle, but to save doubt when the car is being checked, it is wise not to be closer to the limits than, say, $9\frac{1}{16}$ in. to $9\frac{7}{16}$ in. —the odd fraction just isn't worth risking.

When the soft pattern is to your liking, it should be removed and the correct gauge piano wire bent to the pattern. This isn't always as easy as it sounds! But should it not come out right first shot, throw it away. *Do not* attempt to rebend or alter a misplaced loop, as this is a most dangerous practice, and may easily lead to failure. After all, a length of piano wire is very much cheaper than a wrecked car, and maybe an injured spectator. Piano wire just *won't* stand rebending. Any number of tries is well worth the time and money to avoid an accident.

Throughout the job, the most important point is to watch that no sharp bends or kinks are made. One of the most effective ways of forming the loops at the end is to bend the wire round a $\frac{3}{16}$ in. diameter rod and form an end of the shape shown in Fig. 2B. A *steel* washer (4 B.A. to 6 B.A. depending on the wire thickness) slipped over the end completes the loop and it will be found that this makes a most satisfactory job. An alternative is to make the ends as shown in

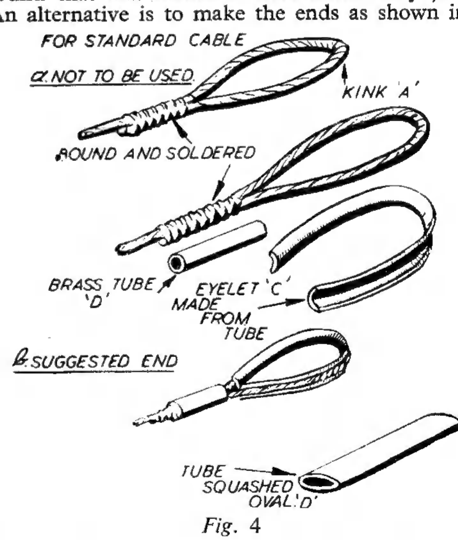


Fig. 4

Fig. 2A, and then bind and solder for at least ¾ in. This type should be tested very carefully as the binding wire is the deciding factor where strength is concerned. The apex of the bridle

should have a bridge bound and sweated across it, which will obviate the danger of the connecting link slipping down towards the car, but does not, of course, add any strength. Great care should be taken to see that the car fittings have radiused edges where the wire fits and that all burrs, etc. are removed.

When the bridle is completed it should be refitted to the car, which can then be suspended as before and checked in front view for tether height. For a start, this can be adjusted whilst in the shop by suspending a plumb-line against the drive tyres, and adjusting the bridle so that the line just touches both drive tyres, or if preferred, just touches the top one whilst clearing the lower one by not more than $\frac{1}{8}$ in., as in Fig. 3B. Final adjustment will vary with different tracks, due to differing heights of the centre poles, and can only be checked after running. Immediately the car has stopped, the temperature of the drive tyres should be felt, and if the outside tyre is the hotter, the bridle should be lowered and vice versa.

The actual part of the car to which the tether fastens should be made amply strong, as at best this can only be tested, in most cases, by suspending the car from a strong hook and hanging on it. If possible the brackets should be arranged to come out at the right height, as it is advisable to keep the amount of packing down to the minimum, otherwise considerable loads will be exerted due to the increased leverage, and in the case of a cast aluminium pan, this can quite easily be sufficient to fracture. For the actual fittings between bracket, or pan, and bridle, motor-cycle chain side plates are a useful source of ready-made parts.

Turning now to the use of flexible cable, the method of balancing will be similar as before, but there is no necessity for the soft wire pattern in this case. First make two or three eyelets for the end loops. A plain loop without support (Fig. 4A) will not make a very satisfactory or neat job, and can be dangerous since the wire tends to kink and becomes brittle at "A," so it is recommended that these eyelets are fitted wherever a loop is used. They can be bought, or quite simply made by taking a short length of $\frac{1}{16}$ in. diameter bore brass tube, with fairly thick walls, and bending it into shape. The radius should be found by testing a piece of the flexible cable, and finding the minimum curve it will take without kinking. The outside of the tube should be filed away to half its diameter for its full length, the result being as in Fig. 4C. Two lengths of brass or copper tube, about $\frac{3}{4}$ in. long and of a bore which will just take two thicknesses of wire should be obtained and squashed to shape as in Fig. 4D. This tube must be seamless. Slip one length of tube on the wire and then double the wire back through the tube and put one of the eyelets in position. Leave about an inch or so of the cable projecting through the tube and push the tube down towards the eyelet. Squeeze the tube in the vice, sufficiently to grip the wire. The spare wire should now be unwound and wound round the main wire as neatly as possible, and the whole lot soldered up well. If using a closed link, such as a chain plate, to connect the bridle to the car, don't forget to put this on at the appropriate place in the sequence!

When cutting the wire to a convenient length (about 18 in. in most cases) put the tube, etc. on the other end, as before, but don't clench up the tube too tight; leave it so that it can be moved. With the car complete, hang up and check the 9 in. dimension, which can be obtained by adjusting the partly finished end. When correct, this can be finished and sweated as before. It now remains to complete the apex, and this should be fitted with a piece of "$\frac{1}{2}$-tube" and bridge-piece as shown in Fig. 5. It may be possible in some cases to use an eyelet at the apex (Fig. 5) but this usually means that the wire will be kinked at "C"—I think the other method is to be preferred.

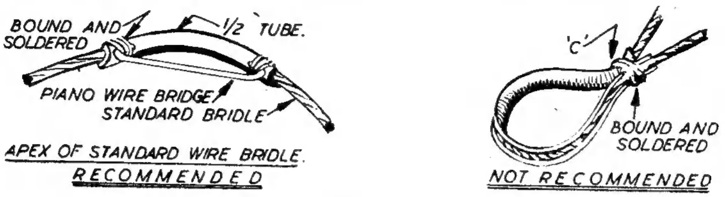


Fig. 5

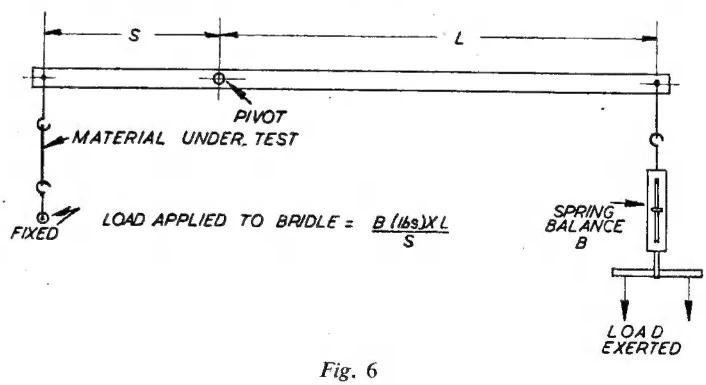


Fig. 6

As mentioned earlier, testing of the bridle to be used on the car is not recommended, unless some subsidiary checks are done as well. A number of typical bridles, say about 6, should be made up and tested, some right to destruction. If the *worst* breaks at more than 2½ times the maximum likely "G" loads, it is fairly safe to assume that the actual bridle will not be any worse, and it can, if you wish, be tested to 1½ times "G," without much fear of overstraining and subsequent failure.

The method of testing most readily available is by means of a lever and an ordinary spring balance, as shown in Fig. 6. This can fairly easily be rigged up, and the spring balance can usually be borrowed. It need not be very expensive or accurate. The length of leverage can be adjusted to bring the necessary load within the range of the available balance. The main beam should preferably be of steel bar, round or square, and the fittings will have to be made to suit the particular situation.

One point not so far mentioned is the clip which connects the car bridle to the line from the centre pole. This is normally the responsibility of the clubs, and not the individual, but since similar links are sometimes used to fasten the bridle to the car, they will be described briefly.

The clip most commonly used is shaped like a paper clip, and made from piano wire or motor-cycle spoke of gauges from 12 s.w.g. for Class 10 down to 16 s.w.g. for Class 1½. Credit for the original introduction of this type of clip must go to Mr. J. Cruikshank and Mr. F. G. Buck. These clips should, of course, be tested in the same way as the bridle, but if used for connecting the cars to the line, must obviously be capable of taking a full weight car at high speed, therefore their strength should not be less than that of the line to the centre-pole.

The construction of the bridle is, unfortunately, of necessity the last job, and so is apt to be rushed, but a little patience, even at the expense of missing a day's running, is preferable to a wrecked car.

It is hoped that these notes may assist some of the less experienced in the attainment of a successful and safe first run with their new car. If in doubt on any point, an enquiry to some more experienced fellow club member will usually bring forth the necessary information and assistance.

For the Bookshelf

Locomotives and their Working, by C. R. H. Simpson, A.I.Loco.E. and F. Browne Roberts, M.B.E., A.M.I.Mech.E. (London: Virtue & Co. Ltd.) In two volumes. 562 pages, size 8 in. by 10½ in. Profusely illustrated. Price £3 10s.

This is basically an instruction book devoted to the construction, working and maintenance of steam locomotives, and it should be of interest and use primarily to enginemen and others associated with locomotive engineering. The steam locomotive, for a long time yet, will remain the chief source of railway tractive power, but the introduction of electric, diesel and gas-turbine locomotives has led the authors of this book to include general descriptions and illustrations of each of these later forms of prime mover.

The book, in itself, is a stupendous work that must have involved much preparation, and the result is, in our opinion, one of the most lucid, instructive and up-to-date reference-books in modern railway literature. The two handsomely-bound volumes are packed with information, presented clearly and concisely, as well as in a thoroughly well-planned manner.

The authors are to be congratulated upon the success with which they have avoided a weakness that has so often marred a book of this kind; they have nowhere overlooked the fact that not all of their readers will be either expert mathematicians or highly-skilled technicians. Their subject frequently and inevitably involves treating of complex technicalities, but the lucidity of their writing ensures that even a first-year student can understand what they have written.

The text is admirably supported by numerous diagrams, drawings and photo-reproductions, several in the form of large folded plates. The frequent use of isometric drawings and tinted diagrams, some in colour, is a notable feature, and the provision of a number of blank pages for readers' notes is to be commended. Every detail of the modern locomotive receives the same careful treatment in both text and illustration; nothing is skimped, despite the economy of words.

The production is excellent, and the problem of keeping a book of this nature within reasonable compass and cost has been approached with courage and overcome to a remarkable degree. Each volume is divided into a number of chapters dealing, respectively, with a specific general feature, and although British locomotive practice is predominant, interesting examples of practice abroad find their due place in this book, especially in cases where there are variations or departures from what Britain regards as normal, but are nevertheless instructive to study.

This is a book that can be perused with profit by all who are interested in or in any way associated with modern locomotive engineering.